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ABSTRACT

The Rate Training Manual is one of a series of training manuals prepared for enlisted personnel of the Navy and Naval Reserve designed to aid Aviation Boatswain's Mate H 2 in preparing for advancement to ABH1 and the ABH1 in preparing for advancement to the rank of ABHC. Chapter 1 discusses the enlisted rating structure, the ABH service ratings, the requirements for advancement, and the advancement opportunities for petty officers. Chapters 2-8 cover the following topics: aircraft handling equipment; aircraft handling; aircraft crashes, firefighting, and crew entrapment; shorebased emergency arresting gear and related equipment; shipboard firefighting; shipboard damage control; and administration. Photographs and diagrams are interspersed throughout the document, which also contains a list of U.S. customary and metric system units of measurements, a subject index, a list of the minimum qualifications for advancement to Aviation Boatswain's Mate H First Class and Chief Petty Officer. A 43-page course assignment booklet for the nonresident career course completes the document. (Author/BP)

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AVIATION

# BOATSWAIN'S MATE H 1 & C

NAVAL EDUCATION AND TRAINING COMMAND

RATE TRAINING MANUAL
AND NONRESIDENT CAREER COURSE

NAVEDTRA 10303-C

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# PREFACE

This Rate Training Manual is one of a series of training manuals prepared for enlisted personnel of the Navy and Naval Reserve who are studying for advancement in the Aviation Boatswain's Mate H (ABH) rating. As indicated by the title, this manual is based upon the professional qualifications for the rates of ABH1 and ABHC, as set forth in the Manual of Qualifications for Advancement, NAVPERS 18068 (Series).

The associated Nonresident Career Course for ABH 1 & C is included as the last section of this manual. Preceding the Nonresident Career Course is a listing of the "quals" for ABH1 and ABHC, as set forth in the Manual of Qualifications for Advancement, which cross-references the "quals" to the assignments in the Nonresident Career Course. Technical questions based upon each qual are provided in the indicated assignment. The ABH1 or ABHC will be greatly assisted in preparing for the advancement examination by making full use of these study aids. This manual and the attendant Nonresident Career Course are valuable aids as review sources for those men preparing for ABCS and ABCM. Their use for everyday on-the-job training is highly recommended.

This training manual was prepared by the Naval Education and Training Program Development Center, Pensacola, Florida, for the Chief of Naval Education and Training. Technical review of the manuscript was provided by personnel of the ABH Schools, NATTC Lakehurst, New Jersey.

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# THE UNITED STATES NAVY

## GUARDIAN OF OUR COUNTRY

The United States Navy is responsible for maintaining control of the sea and is a ready force on watch at home and overseas, capable of strong action to preserve the peace or of instant offensive action to win in war.

It is upon the maintenance of this control that our country's glorious future depends; the United States Navy exists to make it so.

## WE SERVE WITH HONOR

Tradition, valor, and victory are the Navy's heritage from the past. To these may be added dedication, discipline, and vigilance as the watchwords of the present and the future.

At home or on distant stations we serve with pride, confident in the respect of our country, our shipmates, and our families.

Our responsibilities sober us; our adversities strengthen us.

Service to God and Country is our special privilege. We serve with honor.

## THE FUTURE OF THE NAVY

The Navy will always employ new weapons, new techniques, and greater power to protect and defend the United States on the sea, under the sea, and in the air.

Now and in the future, control of the sea gives the United States her greatest advantage for the maintenance of peace and for victory in war.

Mobility, surprise, dispersal, and offensive power are the keynotes of the new Navy. The roots of the Navy lie in a strong belief in the future, in continued dedication to our tasks, and in reflection on our heritage from the past.

Never have our opportunities and our responsibilities been greater.

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Nonresident Career Course follows Qualifications for Advancement




F 5

# CHAPTER 1

# AVIATION BOATSWAIN'S MATE H RATING

Navy training is changing in several ways. For example, it is becoming more and more individualized, a change brought about by the introduction of scores of programmed instruction courses and a few audio/visual courses. These types of courses permit a student to choose his medium of instruction and to proceed at his own pace (self-paced instruction). Then too, all future instructional material must be job related and "system-designed;" that is, it must teach the trainee to do a task, and it must follow a specific course including defining the need, planning, developing, and evaluating the course. Thus all elements required for a complete course will be included in each unit. Training for men and women in many ratings will be planned from the time they enter the Navy until they retire. The objective is to use all the training given and eliminate the "over-training" prevalent in the past. Many, if not all, "A" schools will be reduced in length; some other schools will be eliminated. Consequently, more training must be done aboard the ship or station. To expedite onboard training, a great many "onboard training packages" will be produced.

This training manual is designed to aid the ABH2 in preparing for advancement to ABH1 and the ABH1 in preparing for advancement to ABHC. It is based primarily on the professional requirements or qualifications for ABH1 and ABHC as specified in the Manual of Qualifications for Advancement, NAVPERS 18068 (Series). In preparing for advancement examinations, this manual should be studied in conjunction with Military Requirements for Petty Officers 1 & C, NAVEDTRA 10057 (Series). The latter covers the military requirements for all first class and chief petty officers.

## ENLISTED RATING STRUCTURE

The present enlisted rating structure includes two types of ratings—general ratings and service ratings.

GENERAL RATINGS are designed to provide paths of advancement and career development. A general rating identifies a broad occupational field of related duties and functions requiring similar aptitudes and qualifications. General ratings provide the primary means used to identify billet requirements and personnel qualifications. Some general ratings include service ratings; others do not. Both Regular Navy and Naval Reserve personnel may hold general ratings.

Subdivisions of certain general ratings are identified as SERVICE RATINGS. These service ratings identify areas of specialization within the scope of a general rating. Service ratings are established in those general ratings in which specialization is essential for efficient utilization of personnel. Although service ratings can exist at any petty officer level, they are most common at the PO3 and PO2 levels. Both Regular Navy and Naval Reserve personnel may hold service ratings.

## ABH RATING

The ABH rating is a service rating and is included in Navy Occupational Group IX (Aviation). The general rating, AB, applies at the E-8 and E-9 levels.

Figure 1-1 illustrates all paths of advancement for an Airman Recruit to Master Chief Aviation Boatswain's Mate. Figure 1-2 (A) illustrates the active duty advancement requirements from E-1 thru E-9. Figure 1-2 (B) illustrates the inactive duty advancement requirements.

The Manual of Qualifications for Advancement, NAVPERS 18068 (Series), states that ABHs are responsible for the movement and spotting of aircraft, both ashore and afloat; operate and service ground handling and hoisting equipment; and perform aircraft crash rescue firefighting, crash removal, and damage control duties. ABHs



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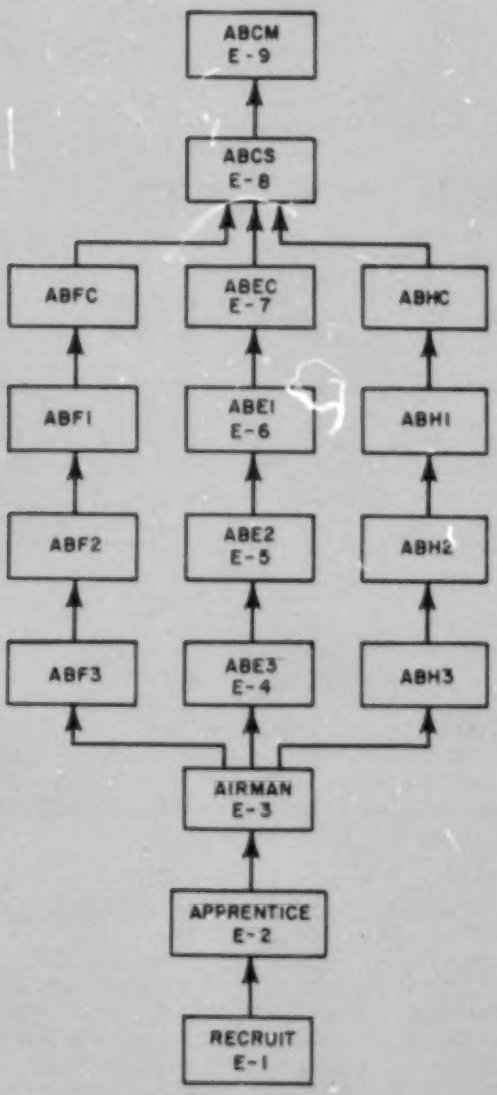


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Figure 1-1. — Enlisted paths of advancement.

also supervise the securing of aircraft and equipment and perform duties in connection with launching and recovery of aircraft.

The ABH1 must be qualified to supervise and conduct inventories and maintain custody records, prepare equipment failure reports, direct flight deck damage control parties, and know the procedures and equipment needed for jettisoning aircraft and equipment.

In addition to the above listed requirements for ABH1, the ABHC must inspect work areas, tools, and equipment to detect potentially hazardous and unsafe conditions and take corrective action, and screen defective components for feasibility of repair.

Along with the necessary tours of sea duty, a wide variety of assignments ashore is available to the ABH. In addition to air station assignments which usually entail a billet in air terminal duties or crash-rescue duties, the ABH1 and ABHC are eligible for assignment to instructor duty as well as a number of other desirable billets. Most of these billets are directly associated with training. Some of the more desirable billets to which the ABH1 and ABHC may be assigned are described in the following paragraphs.

1. Instructor duty is available to both the ABH1 and ABHC in the ABH schools at NATTC, Lakehurst N.J. Another possibility for instructor duty is with the recruit training commands.

2. ABHs are also eligible for assignment to duty with the Naval Education and Training Program Development Center, headquartered at Pensacola, Florida, as a Technical Writer to assist in the preparation of Rate Training Manuals and Nonresident Career Courses (formerly called Enlisted Correspondence Courses) for the AB ratings, and as an exam writer in the preparation of the Navy-wide advancement examinations for enlisted personnel.

For a listing of other special programs and projects, reference should be made to the Enlisted Transfer Manual. Others are also announced from time to time in BUPERS Notices and the quarterly edition of Link (NAVPERS 15980).

Personnel may indicate their desire for assignment to a specific program or project by indicating it in the "remarks" block of their Rotation Data Card.

In today's modern Navy there is an awesome array of weapons and ships. Who can say which one is the most important? It is a known fact that our modern carrier force, whether it be our CVAs or CVs, is one of the big deterrents to any world power thinking of armed conflict. The striking power and the maneuverability of our carriers are what make them so important in the defense of the free world.

E-4 time in service requirements changed by DOD effective 1 July 1975 for advancement to E-4 TIS requirements are increased from 21 months minimum to 2 years.

| REQUIREMENTS * | E1 to E2 | E2 to E3 | # E3 to E4 | #† E4 to E5 | † E5 to E6 | † E6 to E7 | † E7 to E8 | † E8 to E9 |
|---|---|---|---|---|---|---|---|---|
| SERVICE | 4 mos. service- or completion of Recruit Training. | 8 mos. as E-2. | 6 mos. as E-3. | 12 mos. as E-4. 3 years time in service. | 24 mos. as E-5. 6 years time in service. | 36 mos. as E-6. 8 years time in service. | 36 mos. as E-7. 8 of 11 years time in service must be enlisted. | 24 mos. as E-8. 10 of 13 years time in service must be enlisted. |
| SCHOOL | Recruit Training. (C.O. may advance up to 10% of graduating class.) | | Class A for PR3, DT3, PT3, AME 3, HM 3, PN 3, FTB 3, MT 3, | | | Class B for AGC, MUC, MNC.†† | | |
| PRACTICAL FACTORS | Locally prepared check-offs. | Record of Practical Factors, NavEdTra 1414/1, must be completed for E-3 and all PO advancements. | | | | | | |
| PERFORMANCE TEST | | | Specified ratings must complete applicable performance tests before taking examinations. | | | | | |
| ENLISTED PERFORMANCE EVALUATION | As used by CO when approving advancement. | | Counts toward performance factor credit in advancement multiple. | | | | | |
| EXAMINATIONS ** | Locally prepared tests. | See below. | Navy-wide examinations required for all PO advancements. | | | Navy-wide selection board. | | |
| RATE TRAINING MANUAL (INCLUDING MILITARY REQUIREMENTS) | | Required for E-3 and all PO advancements unless waived because of school completion, but need not be repeated if identical course has already been completed. See NavEdTra 10052 (current edition). | | | | | Nonresident career courses and recommended reading. See NavEdTra 10052 (current edition). | |
| AUTHORIZATION | Commanding Officer | NAVEDTRA PRODEVCEN | | | | | | |

* All advancements require commanding officer's recommendation.
† 1 year obligated service required for E-5, and E-6; 2 years for E-7, E-8, and E-9.
# Military leadership exam required for E-4 and E-5.
** For E-2 to E-3, NAVEDTRA PRODEVCEN exams or locally prepared tests may be used.
†† Waived for qualified EOD personnel.

Figure 1-2(A).—Active duty advancement requirements.

| REQUIREMENTS * | E1 to E2 | E2 to E3 | E3 to E4 | E4 to E5 | E5 to E6 | E6 to E7 | E8 | E9 |
|---|---|---|---|---|---|---|---|---|
| TOTAL TIME IN GRADE | 4 mos. | 8 mos. | 6 mos. | 12 mos. | 24 mos. | 36 mos. with total 8 yrs service | 36 mos. with total 11 yrs service | 24 mos. with total 13 yrs service |
| TOTAL TRAINING DUTY IN GRADE † | 14 days | 14 days | 14 days | 14 days | 28 days | 42 days | 42 days | 28 days |
| PERFORMANCE TESTS | | Specified ratings must complete applicable performance tests before taking examination. | | | | | | |
| DRILL PARTICIPATION | Satisfactory participation as a member of a drill unit in accordance with BUPERSINST 5400.42 series. | | | | | | | |
| PRACTICAL FACTORS (INCLUDING MILITARY REQUIREMENTS) | Record of Practical Factors, NavEdTra 1414/1, must be completed for all advancements. | | | | | | | |
| RATE TRAINING MANUAL (INCLUDING MILITARY REQUIREMENTS) | Completion of applicable course or courses must be entered in service record. | | | | | | | |
| EXAMINATION | Standard Exam | Standard Exam required for all PO advancements. Also pass Military Leadership Exam for E-4 and E-5. | | | | | Standard Exam, Selection Board. | |
| AUTHORIZATION | Commanding Officer | NAVEDTRAPRODEVCEN | | | | | | |

*Recommendation by commanding officer required for all advancements.
† Active duty periods may be substituted for training duty.

Figure 1-2(B).—Inactive duty advancement requirements.

This is why you as a senior petty officer in the ABH rating should realize the importance of your position. You, as an ABH, play a very important part in keeping your ship a fighting ship.

As a result of the Naval Leadership Program a considerable amount of material related to naval leadership for the senior petty officer is available. Studying this material will make you aware of your many leadership responsibilities as a senior petty officer, and will also be of great help in developing leadership qualities. It will not in itself, however, make you a good leader. Leadership principles can be taught, but a good leader acquires that quality only through hard work and practice.

As you study this material containing leadership traits, keep in mind that probably none of our most successful leaders possessed all of these traits to a maximum degree, but a weakness in some traits was more than compensated for by strength in others. Critical self-evaluation will enable you to realize the traits in which you are strong, and to capitalize on them. At the same time you must constantly strive to improve on the traits in which you are weak.

Your success as a leader will be decided, for the most part, by your achievements in inspiring others to learn and perform. This is best accomplished by personal example.

## ADVANCEMENT

By this time, you are probably well aware of the personal advantages of advancement—higher pay, greater prestige, more interesting and challenging work, and the satisfaction of getting ahead in your chosen career. By this time, also, you have probably discovered that one of the most enduring rewards of advancement is the training you acquire in the process of preparing for advancement.

The Navy also profits by your advancement. Highly trained personnel are essential to the functioning of the Navy. By advancement, you increase your value to the Navy in two ways. First, you become more valuable as a person who can supervise, lead, and train others; second, you become more valuable as a technical specialist and thus make far-reaching contributions to the entire Navy.

Since you are studying for advancement to PO1 or CPO, you are probably already familiar with the requirements and procedures for advancement. However, you may find it helpful to read the following sections. The Navy does not stand still. Things change all the time, and it is possible that some of the requirements have changed since the last time you went up for advancement. Furthermore, you will be responsible for training others for advancement; therefore, you will need to know the requirements in some detail.

## HOW TO QUALIFY FOR ADVANCEMENT

To qualify for advancement, a person must:

1. Have a certain amount of time in grade.
2. Complete the required military and professional training manuals.
3. Demonstrate the ability to perform all the PRACTICAL requirements for advancement by completing applicable portions of the Record of Practical Factors, NAVEDTRA 1414/1.
4. Be recommended by his commanding officer.
5. Demonstrate his KNOWLEDGE by passing a written examination on (a) military requirements, and (b) professional qualifications.

Remember that the requirements for advancement can change. Check with your educational services office to be sure that you know the most recent requirements.

When you are training lower rated personnel, it is a good idea to point out that advancement is not automatic. Meeting all the requirements makes a person ELIGIBLE for advancement. Such factors as the score made on the written examination, length of time in service, performance marks, quotas, and other factors enter into the final determination of who will actually be advanced.

## HOW TO PREPARE FOR ADVANCEMENT

Preparation for advancement includes studying the qualifications, working on the practical factors, studying the required Rate Training Manuals and any other material that may be specified. To prepare yourself for advancement or to help others prepare for advancement, you will need to be familiar with (1) the "Quals" Manual, (2) the Record of Practical Factors, NAVEDTRA 1414/1, (3) a NAVEDTRA publication called Bibliography for Advancement Study, NAVEDTRA 10052 (Series) and (4) Rate Training Manuals.

The following sections describe these materials and give some information on how to use them to the best advantage.

"Quals" Manual

The Manual of Qualifications for Advancement, NAVPERS 18068 (Series), gives the minimum requirements for advancement to each rate within each rating. This manual is usually called the "Quals" Manual, and the qualifications are of two general types: (1) military requirements, and (2) professional or technical qualifications. Military requirements apply to all ratings rather than to any one rating alone. Professional qualifications are technical or professional requirements that are directly related to the work of each rating.

Both the military requirements and the professional qualifications are divided into subject matter groups. Then, within each subject matter group, they are divided into PRACTICAL FACTORS and KNOWLEDGE FACTORS.

The qualifications for advancement and a bibliography of study materials are available in your educational services office. The "Quals" Manual is changed more frequently than Rate Training Manuals are revised. By the time you are studying this training manual, the "Quals" may have been changed. Never trust any set of "Quals" until you have checked the change number against an UP-TO-DATE copy of the "Quals" Manual.

In training others for advancement, emphasize these three points about the "Quals".

1. The "Quals" are the MINIMUM requirements for advancement. Personnel who study MORE than the required minimum will have a greater advantage when they take the written examinations for advancement.

2. Each "Qual" has a designated rate level—chief, first class, second class, or third class. You are responsible for meeting all "Quals" specified for the rate level to which you are seeking advancement AND all "Quals" specified for lower rate levels.

3. The written examinations for advancement will contain questions relating to the practical factors AND to the knowledge factors of BOTH the military requirements and the professional qualifications.

Record of Practical Factors

A special form known as the Record of Practical Factors, NAVEDTRA 1414/1 is used to record the satisfactory performance of the practical factors. This form lists all military and all professional practical factors. Whenever a person demonstrates his ability to perform a practical factor, appropriate entries must be made in the DATE and INITIAL columns. As a PO1 or CPO, you will often be required to check the practical factor performance of lower rated personnel and to report the results to your supervising officer.

As changes are made periodically to the "Quals" Manual, NAVEDTRA 1414/1 forms are provided when necessary. Extra space is allowed on the Record of Practical Factors for entering additional practical factors as they are published in changes to the "Quals" Manual. The Record of Practical Factors also provides space for recording demonstrated proficiency in skills which are within the general scope of the rate but which are not identified as minimum qualifications for advancement. Keep this in mind when you are training and supervising other personnel. If a person demonstrates proficiency in some skill which is not listed in the "Quals" but which is within the general scope of the rate, report this fact to the supervising officer so that an appropriate entry can be made in that person's Record of Practical Factors.

When you are transferred, the Record of Practical Factors should be forwarded with your service record to your next duty station. It is a good idea to check and be sure that this form is actually inserted in your service record before you are transferred. If the form is not in your record, you may be required to start all over again and requalify in practical factors that have already been checked off. You should also take some responsibility for helping lower rated personnel keep track of their practical factor records when they are transferred.

A second copy of the Record of Practical Factors should be made available to each man in pay grades E-3 through E-6 for his personal record and guidance.

NAVEDTRA 10052

Bibliography for Advancement Study, NAVEDTRA 10052 (Series) is a very important publication for anyone preparing for advancement. This publication lists required and recommended

Rate Training Manuals and other reference material to be used by personnel working for advancement, NAVEDTRA 10052 (Series) is revised and issued once each year by the Naval Education and Training Support Command. Each revised edition is identified by a letter following the NAVEDTRA number. When using this publication, be SURE you have the most recent edition.

The required and recommended references are listed by rate level in NAVEDTRA 10052 (Series). It is important to remember that you are responsible for all references at lower rate levels, as well as those listed for the rate to which you are seeking advancement.

Rate Training Manuals that are marked with an asterisk (*) in NAVEDTRA 10052 are MANDATORY at the indicated rate levels. The completion requirements of a mandatory training manual may be satisfied by (1) passing the appropriate Nonresident Career Course that is based on the mandatory training manual, (2) passing locally prepared tests based on the information given in the mandatory training manual, or (3) in some cases, successfully completing an appropriate Navy school.

When training personnel for advancement, do not overlook the section of NAVEDTRA 10052 which lists the required and recommended references relating to the military requirements for advancement. All personnel must complete the mandatory military requirements training manual for the appropriate rate level before they can be eligible to advance. Also, make sure that personnel working for advancement study the references which are listed as recommended but not mandatory in NAVEDTRA 10052. It is important to remember that ALL references listed in NAVEDTRA 10052 may be used as source material for the written examinations, at the appropriate levels.

## Rate Training Manuals

There are two general types of Rate Training Manuals. Manuals (such as this one) are prepared for most enlisted rates and ratings, giving information that is directly related to the professional qualifications for advancement. Basic manuals give information that applies to more than one rate and rating.

Rate Training Manuals are revised from time to time to bring them up to date. The publication, List of Training Manuals and Correspondence Courses, NAVEDTRA 10061 (Series), which is revised annually, contains a listing of current Rate Training Manuals and their identifying numbers. The letter following the number identifies the latest revision; for example, -A indicates first revision, -B indicates second revision, etc.

Rate Training Manuals are designed for the special purpose of helping naval personnel prepare for advancement. By this time, you have probably developed your own way of studying these manuals. Some of the personnel you train, however, may need guidance in the use of Rate Training Manuals. Although there is no single "best" way to study a training manual, the following suggestions have proved useful for many people:

1. Study the military requirements and the professional qualifications for your rate before you study the training manual, and refer to the "Quals" frequently as you study. Remember, you are studying the training manual primarily to meet these "Quals."

2. Before you begin to study any part of the training manual intensively, get acquainted with the entire manual. Read the preface and the table of contents. Check through the index. Thumb through the manual without any particular plan, looking at the illustrations and reading bits here and there as you see things that interest you.

3. Look at the training manual in more detail, to see how it is organized. Look at the table of contents again. Then, chapter by chapter, read the introduction, the headings, and the subheadings. This will give you a pretty clear picture of the scope and content of the manual.

4. When you have a general idea of what is in the training manual and how it is organized, fill in the details by intensive study. In each study period, try to cover a complete unit—it may be a chapter, a section of a chapter, or a subsection. The amount of material you can cover at one time will vary. If you know the subject well, or if the material is easy, you can cover quite a lot at one time. Difficult or unfamiliar material will require more study time.

5. In studying each unit, write down questions as they occur to you. Many people find it helpful to make a written outline of the unit as they study, or at least to write down the most important ideas.

6. As you study, relate the information in the training manual to the knowledge you already have. When you read about a process, a skill, or a situation, ask yourself some questions.

Does this information tie in with past experience? Is this something new and different? How does this information relate to the qualifications for advancement?

7. When you have finished studying a unit, take time out to see what you have learned. Look back over your notes and questions. Without looking at the training manual, write down the main ideas you have learned from studying this unit. Do not just quote the manual. If you cannot give these ideas in your own words, the chances are that you have not really mastered the information.

8. Use Nonresident Career Courses whenever you can. These courses are based on Rate Training Manuals or other appropriate texts. As mentioned before, completion requirements of a mandatory Rate Training Manual can be satisfied by passing the Nonresident Career Course based on the training manual. You will probably find it helpful to take other courses, as well as those based on mandatory training manuals. Taking additional courses helps you to master the information given in the training manuals, and also gives you an idea of how much you have learned.

## INCREASED RESPONSIBILITIES

When you assumed the duties of a PO3, you began to accept a certain amount of responsibility for the work of others. With each advancement, you accept an increasing responsibility in military matters and in matters relating to the professional work of your rate. When you advance to PO1 or CPO, you will find a noticeable increase in your responsibilities for leadership, supervision, training, working with others, and keeping up with new developments.

As your responsibilities increase, your ability to communicate clearly and effectively must also increase. The simplest and most direct means of communication is a common language. The basic requirement for effective communication is therefore a knowledge of your own language. Use correct language in speaking and in writing. Remember that the basic purpose of all communication is understanding. To lead, supervise, and train others, you must be able to speak and write in such a way that others can understand exactly what you mean.

### Leadership and Supervision

As a PO1 or CPO, you will be regarded as a leader and supervisor. Both officers and enlisted personnel will expect you to translate the general orders given by officers into detailed, practical, on-the-job language that can be understood and followed by relatively inexperienced personnel. In dealing with your juniors, it is up to you to see that they perform their jobs correctly. At the same time, you must be able to explain to officers any important problems or needs of enlisted personnel. In all military and professional matters, your responsibilities will extend both upward and downward.

Along with your increased responsibilities, you will also have increased authority. Officers and petty officers have POSITIONAL authority—that is, their authority over others lies in their positions. If your CO is relieved, for example, he no longer has the degree of authority over you that he had while he was your CO, although he still retains the military authority that all seniors have over subordinates. As a PO1, you will have some degree of positional authority; as a CPO, you will have even more. When exercising your authority, remember that it is positional—it is the rate you have, rather than the person you are, that gives you this authority.

A Petty Officer conscientiously and proudly exercises his authority to carry out the responsibilities he is given. He takes a personal interest in the success of both sides of the chain of command authority and responsibility. The Petty Officer who does not seek out and accept responsibility, loses his authority and then the responsibility he thinks he deserves. He must be sure, by his example and by his instruction, that the Petty Offficers under him also accept responsibility. In short, he must be the leader his title—Petty Officer—says he is.

### Training

As a PO1 or CPO, you will have regular and continuing responsibilities for training others. Even if you are lucky enough to have a group of subordinates who are all highly skilled and well trained, you will still find that training is necessary. For example, you will always be responsible for training lower rated personnel for advancement. Also, some of your best workers may be transferred, and inexperienced or poorly trained personnel may be assigned to you. A particular job may call for skills that none of your personnel has. These and similiar problems require that you be a training specialist—one who can conduct formal and informal training programs to qualify personnel for advancement, and one who can train individuals and groups in the effective execution of assigned tasks.

In using this training manual, study the information from two points of view. First, what do you yourself need to learn from it? And second, how would you go about teaching this information to others?

Training goes on all the time. Every time a person does a particular piece of work, some learning is taking place. As a supervisor and as a training expert, one of your biggest jobs is to see that your personnel learn the RIGHT things about each job so that they will not form bad work habits. An error that is repeated a few times is well on its way to becoming a bad habit. You will have to learn the difference between oversupervising and not supervising enough. No one can do his best work with a supervisor constantly supervising. On the other hand, you cannot turn an entire job over to an inexperienced person and expect that person to do it correctly without help or supervision.

In training lower rated personnel, emphasize the importance of learning and using correct terminology. A command of the technical language of your occupational field enables you to receive and convey information accurately and to exchange ideas with others. A person who does not understand the precise meaning of terms used in connection with his work is definitely at a disadvantage when he tries to read official publications relating to his work. He is also at a great disadvantage when he takes examinations for advancement. To train others in the correct use of technical terms, you will need to be very careful in your own use of words. Use correct terminology and insist that personnel you are supervising use it too.

You will find the Record of Practical Factors, NAVEDTRA 1414/1, a useful guide in planning and carrying out training programs. From this record, you can tell which practical factors have been checked off for each person and which ones have not yet been done. Use this information to plan a training program that will fit the needs of the personnel you are training.

On-the-job training is usually controlled through daily and weekly work assignments. When you are working on a tight schedule, you will generally want to assign each person to the part of the job that you know he can do best. In the long run, however, you will gain more by assigning personnel to a variety of jobs so that each person can acquire broad experience. By giving people a chance to do carefully supervised work in areas in which they are relatively inexperienced, you will increase the range of skills of each person and thus improve the flexibility of your working group.

### Working with Others

As you advance to PO1 or CPO, you will find that many of your plans and decisions affect a large number of people, some of whom are not even in your own occupational field. It becomes increasingly important, therefore, for you to understand the duties and the responsibilities of personnel in other ratings. Every petty officer in the Navy is a technical specialist in his own field. Learn as much as you can about the work of others, and plan your own work so that it will fit into the overall mission of the organization.

### Keeping Up With New Developments

Practically everything in the Navy—policies, procedures, publications, equipment systems—is subject to change and development. As a PO1 or CPO, you must keep yourself informed about changes and new developments that affect you or your work in any way.

Some changes will be called directly to your attention, but others will be harder to find. Try to develop a special kind of alertness for new information. When you hear about anything new in the Navy, find out whether there is any way in which it might affect your work. If so, find out more about it.

## SOURCES OF INFORMATION

As a PO1 or CPO, you must have an extensive knowledge of the references to consult for accurate, authoritative, up-to-date information on all subjects related to the military and professional requirements for advancement.

Publications mentioned in this chapter are subject to change or revision from time to time—some at regular intervals, others as the need arises. When using any publication that is subject to revision, make sure that you have the latest edition. When using any publication that is kept current by means of changes, be sure you have a copy in which all official changes have been made.

A list of training manuals and publications that will be helpful as references and for additional study in preparing for advancement is included in the reading list at the beginning of the text. Additional training manuals that are applicable are available through your educational services officer.

In addition to training manuals and publications, training films furnish a valuable source of supplementary information. Films that may be helpful are listed in the U. S. Navy Film catalog, NAVAIR 10-1-777.

## ADVANCEMENT OPPORTUNITIES FOR PETTY OFFICERS

Making chief is not the end of the line as far as advancement is concerned. Advancement to Senior (E-8) and Master (E-9) Chief, Warrant Officer, and Commissioned Officer are among the opportunities that are available to qualified petty officers. These special paths of advancement are open to personnel who have demonstrated outstanding professional ability, the highest order of leadership and military responsibility, and unquestionable moral integrity.

## PROFICIENCY PAY

The determination as to which Navy ratings, NECs, and Special Duty Assignments are authorized proficiency pay is accomplished through an annual review within the Bureau of Naval Personnel. Those ratings, NECs or special duty assignments which fulfill the Department of Defense criteria for an award of proficiency pay are included in a proposed fiscal year Proficiency Pay Program submitted to the Secretary of Defense for approval.

The Secretary of Defense has authorized two categories of Proficiency Pay for Navy personnel:

1. Shortage Specialty (Proficiency Pay). A monthly amount of pay in addition to any pay and allowances to which otherwise entitled that may be awarded to an eligible enlisted member who possesses a critical rating or NEC. Shortage Specialty pay is designed to assist in attaining and sustaining adequate career manning levels in critical ratings and NECs.

2. Special Duty Assignment (Proficiency Pay). A monthly amount of pay in addition to any pay and allowances to which otherwise entitled that may be awarded to an eligible enlisted member who is assigned to certain special duties. Special Duty Assignment pay is designed to assist in attaining and sustaining an adequate volunteer manning level in the critical special duty assignments.

## ADVANCEMENT TO SENIOR AND MASTER CHIEF

Chief petty officers may qualify for the advanced grades of Senior and Master Chief. These advanced grades provide for substantial increases in pay, togeather with increased responsibilities and additional prestige. The requirements for advancement to Senior and Master Chief are subject to change but, in general, include a certain length of time in grade, a certain length of time in the naval service, a recommendation by the commanding officer, and a sufficiently high mark on the Navy-wide examination.

### Examination Subjects

Qualifications for advancement to Senior Chief Petty Officer and Master Chief Petty Officer have been developed and published in the Manual of Qualifications for Advancement, NAVPERS 18068 (Series). They officially establish minimum military and professional qualifications for Senior and Master Chief Petty Officers.

The Bibliography for Advancement Study, NAVEDTRA 10052 (Series) contains a list of study references which may be used to study for both military and professional requirements.

The satisfactory completion of the Nonresident Career Course titled Military Requirements for Senior and Master Chief Petty Officer, NAVEDTRA 91209, is mandatory for advancement to E-8 and E-9.

## ADVANCEMENT TO WARRANT AND COMMISSIONED OFFICER

It has been demonstrated that the Navy has a need for warrant officers to serve as officer technical specialists, and limited duty officers to serve as officer technical managers.

On 5 December 1974, the Secretary of the Navy approved recommendations for improvement of the warrant officer and limited duty officer programs. The changes as set forth in BUPERS notice 1120 of 24 January 1975 will be in effect until incorporated into the BUPERSMAN.

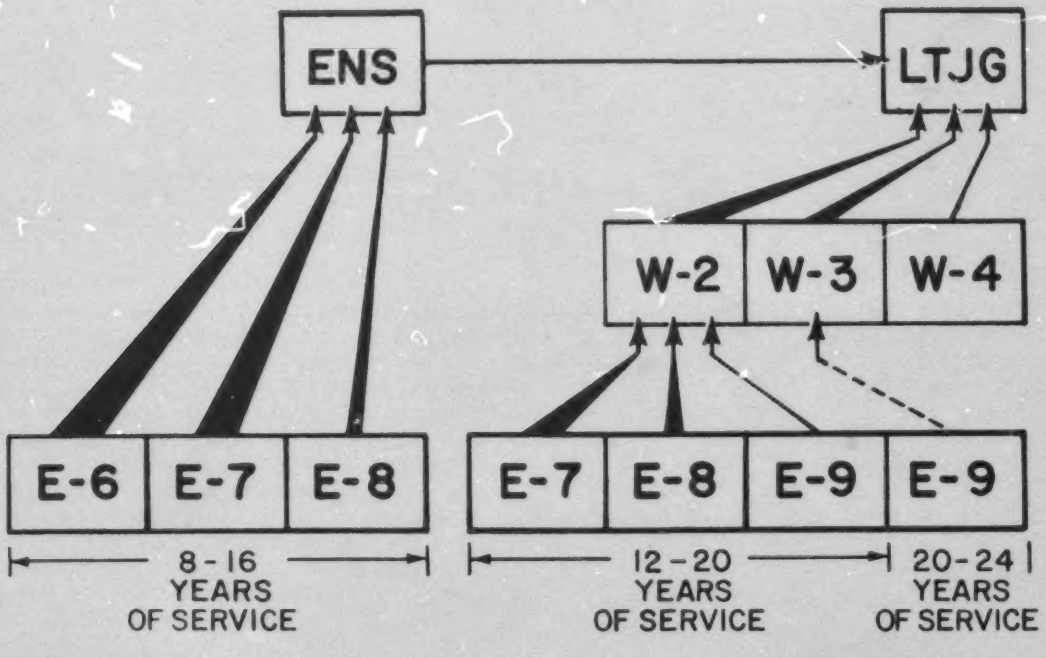


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Figure 1-3. — LDO/WO career paths.

New paths from enlisted to warrant and LDO, and from warrant to LDO, are shown in figure 1-3. Application may be made for a grade indicated by an arrow. E-7s and E-8s with 12 to 16 years may not apply simultaneously for LDO ensign and W-2. Only two applications may be made while in any one pay grade.

Once appointed W-2, ex-enlisteds will continue progression to W-3, then W-4 as in the past, or after two years of warrant service, may apply for LDO Lt.(jg). Once appointed LDO ensign, ex-enlisteds will progress through the LDO grades as in the past.

The dotted line from the second E-9 box at the extreme right of figure 1-3 means that E-9s with two years of performance equivalent to W-2 duties, may be recommended by the procurement board for appointment as W-3 instead of W-2.

Enlisted personnel of the Regular Navy and Naval Reserve on active duty may seek appointment to warrant status via the Warrant Officer Program or regular commissioned status via the Limited Duty Officer Program.

Personnel seeking appointment under either of the programs should familiarize themselves with the laws and regulations governing appointment, retirement, reversions, and career matters as contained in the Career Planning Information Booklet NAVPERS 15176 for aviation.

Eligible applicants for the Warrant Officer and Limited Duty Officer program will be considered by a selection board. The board will recommend those deemed best qualified for appointment within authorized quota limitations.

Competition in both of the programs has been and will continue to be particularly keen, and personnel should commence preparation early in their careers. Increased knowledge by on-the-job training and specialized training through schools and correspondence courses should be sought by all potential candidates to better prepare for officer status.

# CHAPTER 2

# AIRCRAFT HANDLING EQUIPMENT

There are many types of mobile and nonmobile equipment used by the ABH, and each has a specific job. The ability to operate and maintain this equipment is the key to maximum performance. Tractors, spotting dollies, cranes, chocks, tow bars, and tiedowns are the tools of the plane director and handler. As with all tools, their safe and proper use is required to perform a creditable job. The ABH1 and ABHC must have a knowledge of their capabilities in order to supervise their use.

## TOW TRACTORS

Most present day aircraft are too heavy and large to be moved by manpower alone. Therefore, the tow tractor is a means of propulsion for the majority of aircraft when the aircraft is on the ground and the engines are not running.

The characteristics of importance to the ABH are the tow tractor's maneuverability, weight, drawbar pull, engine and transmission type, and the type of aircraft support equipment that may be installed.

Maneuverability of the tractor depends on its dimensions and turning radius. The smaller the dimensions and turning radius the more maneuverable the tractor will be. The type of transmission may also contribute to the ease of handling of the tractor.

The drawbar pull is the amount of force that the tractor can exert. The drawbar pull of any tractor is dependent on the type and condition of the surface on which it is being used. Dry concrete gives the most traction, hence the most drawbar pull for a given tractor. On a wet, fuel-soaked steel or wooden flight deck, the tractive force may be almost nil.

Support equipment for supplying electric power and/or low compressed air for aircraft engine starting or servicing and electric power for brake operation may be installed on some tractors.

Tow tractors are usually classified by one of two designations—the M series and the TA series. Some tractors may have both designations. The first two letters of the M series do not have a standard meaning. The number in the M series is the model number. A letter following the model number indicates the number of modifications to that model tractor. An A indicates the first modification, etc. The TA in the TA series denctes Tractor, Aircraft. The numbers following the TA indicate the first two numbers of the drawbar pull; for example, the TA-75 has a drawbar pull of 7,500 pounds.

## HOUGH TA-18 GASOLINE

The TA-18 (fig. 2-1) is a gasoline-powered tractor with four-wheel drive, designed for towing and spotting large aircraft at relatively low speeds (less than 20 mph). Front and rear tow fittings are provided to facilitate positioning its load. Both steering and brakes are power assisted. Power for the tractor is provided by a V-8, high-torque, heavy duty gasoline engine, which is water cooled. The transmission is a fully automatic unit providing six forward speeds and a reverse speed. The maximum permissible road speed is 5 mph in LO-2, 10 mph in 3-4, 14 mph in 3-5, and 20 mph in 3-HI. All automatic shift points are controlled by a combination of engine speed, engine loading, and throttle opening. Shifts can be made by the operator by manual setting of the transmission shift lever.

CAUTION: This should never be done in such a manner as to cause the tractor to exceed, in any gear range, the maximum speeds given above.

The tractor weighs 25,800 pounds and exerts a drawbar pull of 18,000 pounds. It is 14 feet 10 inches long, 8 feet wide, and 5 feet 7 inches high with a minimum ground clearance of 13 inches. The turning radius is 24 feet 10 inches.

Some of these tractors are provided with weather protection for the driver, while others have an open driving position.

TA-75 GASOLINE

The TA-75 (fig. 2-1) is a gasoline-powered tractor intended for use as an aircraft spotting vehicle for aircraft up to 75,000 pounds. The tractor has provisions for mounting a gas turbine compressor to be used in starting jet engines. It is equipped with a three-speed automatic transmission that is pushbutton-operated from the dash panel. The dimensions are 10 feet long, 5 feet 6 inches wide, and 4 feet 6 inches high. The turning radius is 10 feet. The drawbar pull is 7,500 pounds, and the weight is 10,500 pounds.

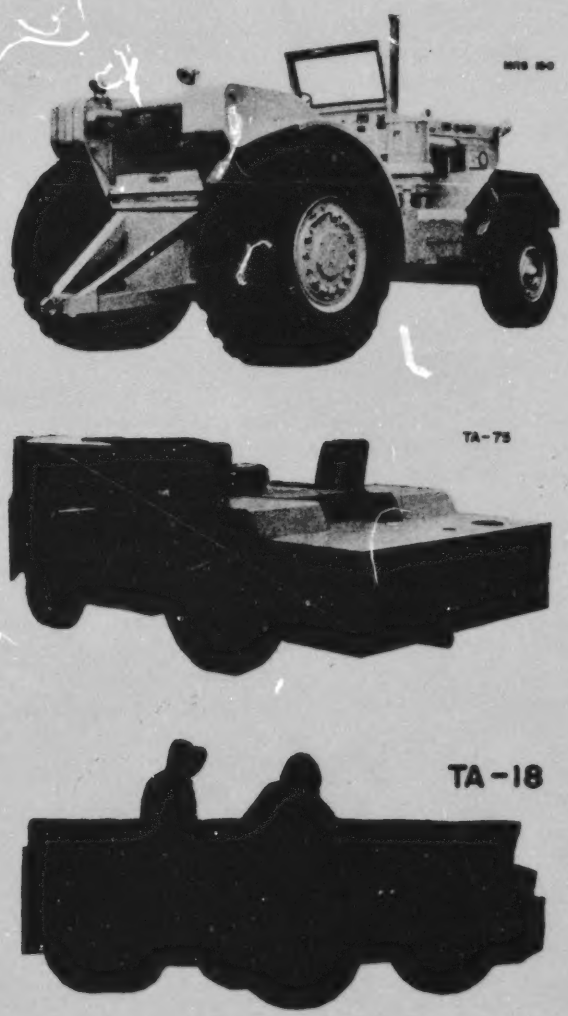


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Figure 2-1.—Tow tractors.

M-R-S 190 DIESEL

The M-R-S 190 (fig. 2-1) airfield arresting gear tow tractor is intended for use in positioning arresting gear chain on runways at air stations. It is powered by a six-cylinder, 335-horsepower full diesel engine, and is equipped with a selective-type transmission providing five forward speeds and one reverse speed. Steering is by conventional steering gear with reduction and a hydraulic booster. It has two-wheel drive with two-wheel air-over-hydraulic brakes. The equipment is complete with all controls, switches, and indicators necessary for normal operation. This tractor is a huge piece of equipment. It weighs approximately 47,300 pounds, is 17 feet 4 inches long, 9 feet 6 inches wide, with a ground clearance of 15 inches, and is capable of exerting sufficient drawbar pull to perform any work that may be required.

HOUGH MD-3/3A DIESEL

The MD-3 (fig. 2-2) is designed to tow aircraft on various types of surfaces in various kinds of inclement weather that may be experienced through an ambient temperature range of 25° F and 125° F. This tractor is a self-contained unit capable of developing 8,500 pounds of drawbar pull on dry, level concrete (nonskid) at an approximate speed of 1 mph.

A gas turbine compressor (GTCP-100) may be mounted at the rear of this tractor, supplying pneumatic power in the form of compressed air for the operation of large class pneumatic equipment, such as aircraft main engine starters, air conditioning systems, and other large consumers of compressed air.

The main powerplant for this tractor is an internal diesel combustion, four-stroke cycle, six-cylinder engine. The steering system is hydraulically assisted, and the service brakes are assisted by compressed air. The transmission is a multiple reduction drive unit

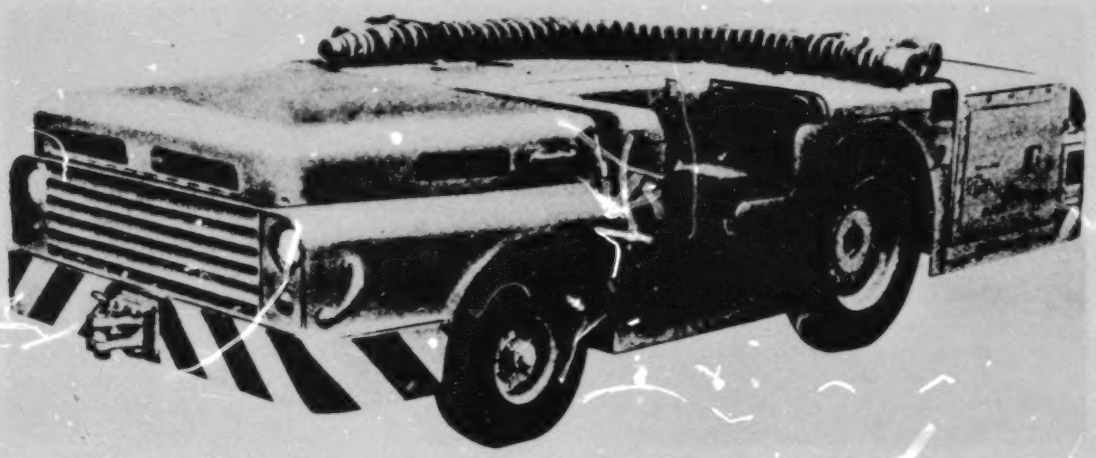

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Figure 2-2.—MD-3/3A Aircraft tow tractor.

(three speed ranges forward—one range reverse) that shifts automatically in all forward gears. The MD-3/3A presents a low silhouette for maneuverability in congested areas. The tractor weighs 12,000 pounds and is 13 feet 5 inches long, 5 feet 5 inches wide, and 3 feet high with a minimum ground clearance of 7 1/2 inches. The turning radius is 11 feet 0 inches.

## OPERATION

Supervision of tow tractor operation is a major concern of the ABH1 and ABHC. Although he will not normally drive or operate the tractor, the ABH1 and ABHC must know the operating procedures and be able to carry on a training program for lower rated personnel.

Drivers who perform towing operations must be fully qualified. In other words, no attempt should be made to train a new driver during actual towing operations. Driver training is an operation of its own and must be carried on in an area where traffic can be controlled and the aircraft being towed is not likely to strike anything.

Tractors should not be used to push or pull any equipment other than that specified by local directives. As a general rule, a tractor can safely tow an aircraft weighing ten times its drawbar pull over dry, level concrete. Of course, weather conditions and terrain can affect the weight that the tractor can safely tow.

Tractors with four-wheel drive have a turning radius twice that of rear-wheel drive tractors and are more difficult to turn and maneuver.

Tractors equipped with air brakes must not be moved until the air tank reaches its full rated operating pressure. This requires a minute or so after starting the engine. A red light on the panel lights up anytime the air pressure is low.

The proper approach to an aircraft must be that of sound judgment on the part of the driver and/or plane director. A tractor should never be permitted to pass under any part of an aircraft unless it is absolutely essential to the towing operation. When this is necessary, personnel must be stationed so that all clearances between the tractor and aircraft can be observed.

Someone other than the tractor driver should be present to hook the tractor to the tow bar. If the driver must do this, the tractor engine must be stopped and the parking brake set before getting off the tractor.

NOTE: Aboard ship, whenever a tractor is not manned, it must be chocked in addition

to setting the parking brake, regardless of the time period it is to be unmanned.

After hookup of the tow bar is made, no attempt should be made to move an aircraft until a fully qualified man is in the cockpit of the aircraft—one who fully understands the operation to be performed.

Extreme care must be taken when backing a towed aircraft to avoid jackknifing the tractor into the tow bar.

Towing speed should be limited to 5 miles per hour at all times.

More detailed information on towing operations is contained in ABH 3 & 2, chapter 4.

## MAINTENANCE

Due to the weight of modern aircraft in the Navy today, aircraft tow tractors are one of the ABH's most important items of equipment. It is virtually impossible to physically move an aircraft without them, let alone to do it safely and/or to respot to meet the requirements of the flight schedule. Therefore, it is necessary for tow tractors to be kept in the best condition possible.

In order to keep tractors and/or enclosures ready for service, it is a must that an inspection and preventive maintenance program be set up. Preventive maintenance is also a factor in accident prevention. In equipment, the failure of a single part may cause the loss of the entire assembly. Loss of that equipment may cause the loss of personnel, and may be the difference between success or failure of an important mission. It has been determined that good preventive maintenance will keep a piece of equipment in safe and working order for a long time. An enforced preventive maintenance program is the key to a successful operation.

The maintenance and repair of tow tractors, as well as all ground support equipment, is performed by the Aircraft Intermediate Maintenance Department (AIMD), or the activity having permanent custody of the equipment. However, in order to properly carry out his duties as a tractor driver and/or supervisor of aircraft towing operations the ABH must have some knowledge of the mechanical difficulties that may be encountered in their operation. Some of these difficulties have been discussed in preceding paragraphs.

It is the responsibility of the tractor driver to complete the daily and preoperational inspections as described in the applicable Maintenance Requirements Cards (MRCs).

It is the responsibility of the supervisor to ensure that these inspections and servicing of the tow tractor are carried out in an approved manner. A tractor should never be used in a towing operation until the daily and preoperational inspections have been made in accordance with the Maintenance Requirements Cards and any noted discrepancies corrected. Minor difficulties should be noted and corrected to avoid the development of major repairs and unnecessary "down" time.

## SAFETY PRECAUTIONS

The importance of safety cannot be overstressed. The safety factor is one of the first considerations of any job. After an accident has happened, investigation almost invariably shows that it could have been prevented by the exercising of simple safety precautions which are then posted for future guidance, but which never undo the consequences of the accident that has gone before. Safety precautions must always be observed.

One of the major causes of accidents is the lack of attention to the job being done. The safety precautions necessary for the safe operation of each piece of equipment should be studied and discussed at length with personnel concerned before any operation is attempted.

The safety precautions are issued by individual commanding officers to suit particular needs of activities, ships, and operating schedules. All personnel concerned with tow tractor operation should be familiar with these instructions.

Only qualified drivers should be allowed to operate a tow tractor. A qualified driver is one who has satisfactorily completed a training program in the operation of towing equipment, has read and understands the operations section of the technical manual for the tractor he is to operate, and knows and understands the standard signals used in the directing of aircraft towing.

The following precautions are to be observed while aircraft are being towed.

1. Look in the intended direction of travel to be sure no personnel or obstructions are

in the way. Sufficient clearances must exist on all sides of the tractor and load while both are moving as a unit.

2. Move slowly on wet or slippery surfaces and in congested areas.

3. Pull the load gradually and tow it at a steady rate, keeping in mind the type of surface being traveled. Tow in a gear range and at a speed that minimizes sudden speed changes; i.e., operate in a speed range that will allow full acceleration of the engine, and allow ample turning space.

The tow tractor should be used only for those jobs for which it was designed or has been authorized. It is not a "wrecker" and should not be used to push-start other tractors or vehicles. Passengers should be carried only on those tractors that have seats installed for this purpose. Tractors should not be used as a truck to haul parts or other equipment.

The MAXIMUM speed limit for a tractor towing an aircraft is 5 mph. The tractor must be operated so as to avoid any sudden stops or starts. Extreme care must be taken when towing an aircraft over rough ground and/or arresting gear pendants. Jerking, bumping, and bouncing can quickly disconnect the tow bar from the aircraft or tractor.

When a tractor is operated on which a gas turbine compressor is installed, additional safety precautions must be observed. The starting and operating procedures for the turbine are given on a plate fixed to the tractor instrument panel and must be followed. Before the unit is started, make sure the area around the compressor inlet and exhaust outlet is clear of all loose gear. All personnel must stand clear of the compressor air inlet, the exhaust outlet, and the area adjacent to the plane of rotation of the high-speed compressor and turbine assembly. Personnel handling the flexible air ducts should wear asbestos gloves when connecting and disconnecting the duct to the aircraft, and stand well clear of the duct quick-disconnect fittings during starting operations.

NOTE: Extreme care must be exercised in the approach and final spot when using a tractor equipped with a high-speed compressor and turbine assembly to ensure that the extremely high temperature of the exhaust is not directed against aircraft, ordnance, fueling hoses, or personnel, etc.

The ABH1 and ABHC supervising the use of tow tractors must, as a part of their responsibilities, insist that only proper operating and maintenance procedures be followed and that all safety precautions be observed.

## AIRCRAFT SPOTTING DOLLY MODEL SD-1C

The SD-1C aircraft spotting dolly (fig. 2-3) is a self-contained diesel engine driven unit intended for use in towing, turning, and spotting carrier-type aircraft, providing maximum maneuverability in congested areas with only one-man operation.

The spotting dolly is a three-wheeled unit, two of the wheels being driven and the third, a free-wheeling caster. A diesel prime mover drives two variable displacement pumps which supply varying amounts of power to hydraulic motors which drive the wheels. A third pump maintains a positive head on the hydraulic systems and supplies control pressures.

The lifting arms (fig. 2-4) are hydraulically controlled by a main hydraulic cylinder and two secondary hydraulic cylinders. The arms house different size axle pins for engagement with the nosewheel of specific types of aircraft.

The SD-1C spotting dolly has a drawbar pull rating of 6,000 pounds and a nosewheel lifting capacity of 16,000 pounds for maneuvering aircraft on its own landing gear to any desired position. This dolly is equipped with a 28-volt, 40-ampere, dc output to supply aircraft needs during spotting operations.

Control of the dolly is accomplished through a single handle on the end of the control arm. (See fig. 2-3.) Steering is accomplished by pushing the handle left or right, speed and direction (forward or reverse) by twisting the handle. The operator may walk with the unit, or ride on the operator's seat, controlling it with a single hand.

CAUTION: Maximum speed is 5 miles per hour loaded and 10 miles per hour unloaded.

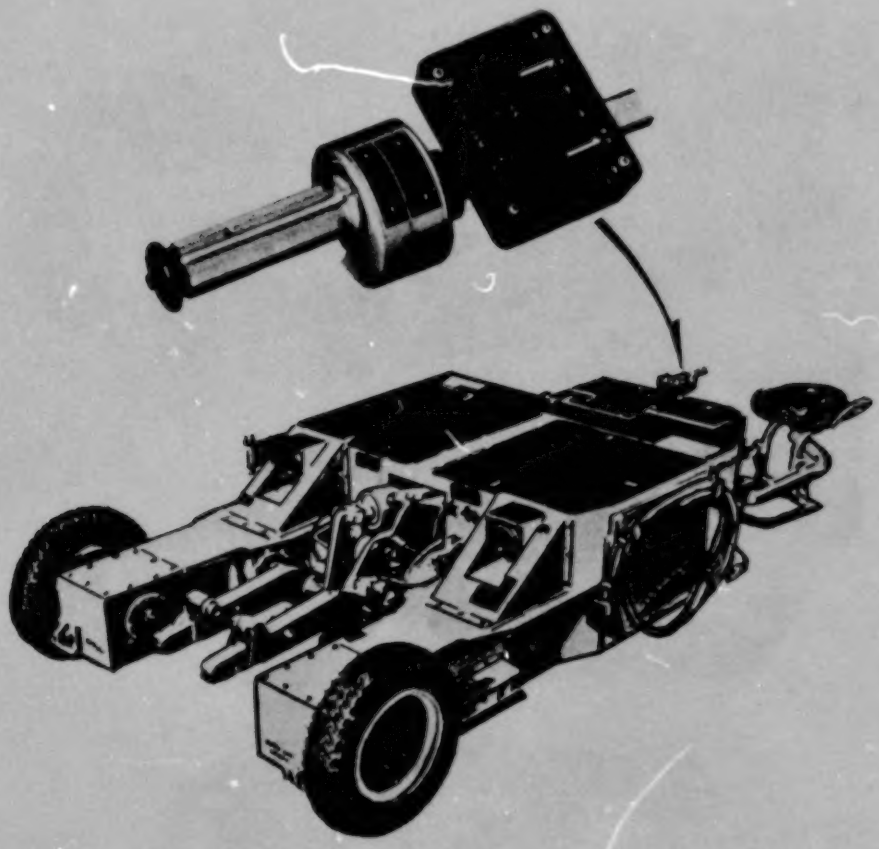

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Figure 2-3.—Aircraft Spotting Dolly (SD-1C).

The dolly is 11 feet 7 inches long, 6 feet 3 inches wide, and 29 inches high, with a gross weight of 5,500 pounds. Self-propelled, the spotting dolly moves an aircraft by picking up its nosewheel and moving it in any direction with no turning radius required by the spotting dolly.

When the spotting dolly is used to move an aircraft, the usual manner is to set the brakes on the main landing gear, lower the lifting arms, drive the dolly under the nosewheel, insert two axle pins in the lifting arms, raise the lifting arms, release the aircraft's brakes, and drive away.

The dolly is also equipped with removable fork lift tines that can be used for lifting pallets with weights up to 2,000 pounds.

## SD-1D SPOTTING DOLLY

The model SD-1D Spotting Dolly is discussed in chapter 4 of the ABH 3 & 2 NAVEDTRA 10300-C, along with a table of leading particulars of each spotting dolly. Unlike the SD-1C, the SD-1D does not have the 28-volt dc output for aircraft needs. (See fig. 2-5.)

## FORKLIFT TRUCK

The forklift truck (fig. 2-6) is probably the most widely used power-driven piece of material handling equipment in the Navy. A forklift truck is a motorized vehicle designed to pick up, carry for a short distance, and

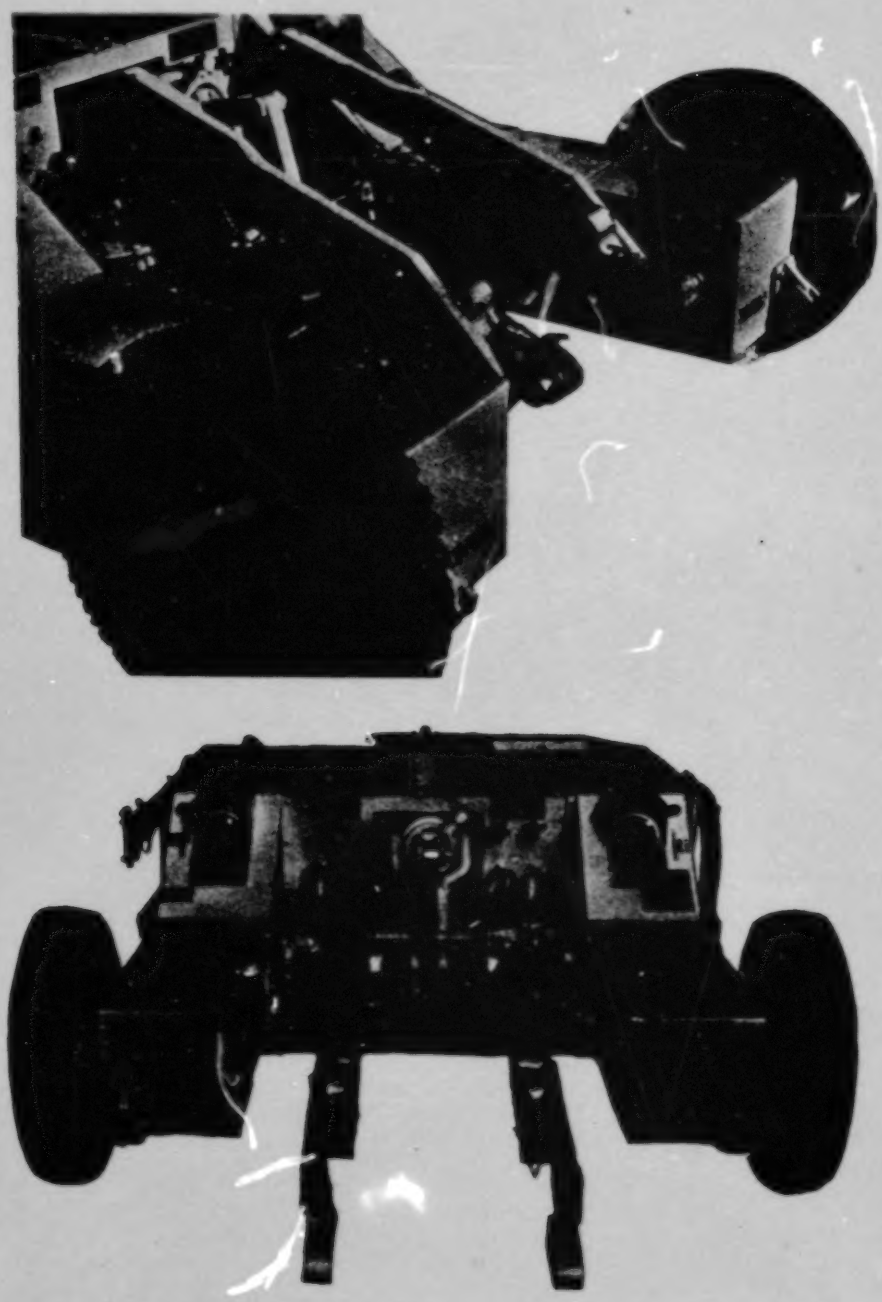

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Figure 2-4.—Aircraft nosewheel lifting assembly.

stack unit loads of supplies and equipment. Standard forklift trucks are available with lifting capacities of 2,000 to 15,000 pounds and lifting heights of 100 to 210 inches.

## GENERAL CHARACTERISTICS

Forklift trucks are equipped with telescopic masts that permit loads to be lifted beyond the height of the collapsed mast. Most trucks have free lift, which is the height to which the forks can be raised before the inner sides move upward from the mast and increase the overall height.

Gasoline- or diesel-powered forklift trucks may be equipped with solid or semisolid tires for use in warehouses, or pneumatic tires for use in outdoor areas. Electric-powered forklift trucks are equipped with solid or semisolid tires for use indoors only.

Forklift trucks are used to handle palletized unit loads. They are also used for handling boxes and containers equipped with skids and other large rigid containers or packages. Forklift trucks are used aboard ship, ashore, and to load and unload aircraft.

Forklift trucks should not travel with individual loads more than 400 feet. If the operation requires longer travel, the forklift truck should load the material on hauling equipment and unload it for stacking or loading aboard an aircraft.

## SAFETY

Forklift trucks are rated to the maximum weight they can safely lift. This load weight should never be exceeded. For stability, the load should be carried as close to the mast

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Figure 2-5.—Aircraft Spotting Dolly (SD-1D).

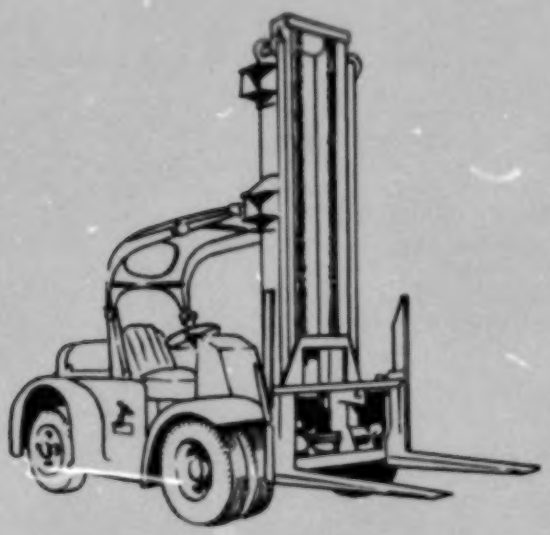

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Figure 2-6.— Fork lift truck.

as possible, and the lift should be positioned as low as possible before moving. When learning to operate a forklift truck, a safe policy to follow is to perform one maneuver or movement at a time. For example: go to your load with the lift down; stop; pick up your load and lock the lift in a carrying position, and then move to the unloading point. Especially when loaded, turn slowly and avoid sudden stops to prevent the load from tipping or slipping from the pallet or forks. Back down a hill or ramp to prevent the load from sliding off.

The forklift truck should be used only for the work it was designed to perform. When you, as the forklift operator, cannot see over or around your load, use a walking guide to signal your needed movements to you. Figure 2-7 shows approved techniques for loading and unloading an aircraft with a forklift. The shaded portions are areas where vehicles should not be operated and areas in which equipment and cargo should not be placed.

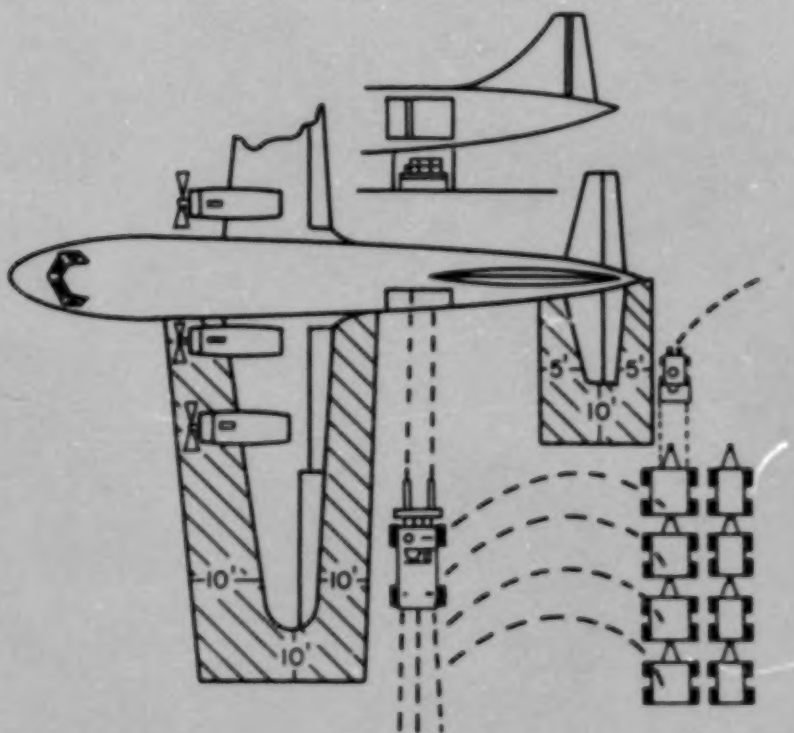


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Figure 2-7.— Loading and unloading techniques.

## AIRCRAFT CRANES

Cranes are installed on carriers, cruisers, and auxiliaries for handling airplanes, boats, missiles, bombs, torpedoes, mines, trucks, paravanes, and stores. The number of cranes per ship vary, depending upon the specific requirements of the ship involved.

Cranes are designed to meet the following conditions:

1. Hoist, lower top, and rotate rated load at the specified speed, and against a specified list of the ship.
2. Handle 150-percent rated load at no specified speed.
3. Withstand a static, suspended load of 200 percent rated load without damage or distortion to any part of the crane or structure.

The types of cranes installed on the ship vary according to the equipment handled, and are classified in general type and type of drive as follows:

1. General type:
   a. Rotating king post. (See fig. 2-8.)
   b. Stationary king post.
   c. Fixed topping lift.
   d. Variable topping lift.
   e. Jib.

2. Type of drive:
   a. Electric-hydraulic.
   b. Straight electric.
   c. Gasoline engine.
   d. Diesel engine.
   e. Hand-operated.

### DESCRIPTION

The crane equipment, in general, includes the boom, king post, king post bearings, sheaves, hook and rope, machinery platforms, rotating gear, drums, hoisting, topping and rotating drives, and control.

Electric-hydraulic cranes are installed where wide range of speed, delicate control, and smooth acceleration and deceleration are required, as in the case of aircraft handling.

Electric-hydraulic equipment for the cranes consists of one or more electric motors, running at constant speed, each of which drives one or more variable displacement hydraulic pumps whose strokes are controlled through operating handwheels. "Start," "stop," and "emergency run" pushbuttons are located at the operator's station adjacent to the operating handwheels for the control of the electric motors. Interlocks are provided to prevent starting the electric motors when the hydraulic pumps are on stroke.

The fixed crane on most carriers is of the rotating king post type with electrohydraulic drive.

The description and capabilities of the crane given here are for the aircraft carriers, CVA-59, 60, and 61. The machinery for this crane consists of an electrohydraulic aircraft hoisting unit, cargo hoisting unit, and rotating unit. Each unit has a single speed, nonreversing electric motor driving a hydraulic variable displacement pump which in turn drives its connected hydraulic fixed displacement motor and gear reducer.

The gear reducer for the aircraft hoisting unit drives a single grooved spooling drum. The aircraft hoisting unit is capable of the following operation:

1. A pull of 14,500 pounds at the drum gives the 1 1/8-inch diameter wire rope a travel of 80 feet per minute when handling a useful hook load of 50,000 pounds traveling at 20 feet per minute with a four-part purchase arrangement.

2. A pull of 900 pounds at the drum causes the wire rope to travel at 240 feet per minute when handling an empty hook traveling at 60 feet per minute with a four-part purchase arrangement.

The gear reducer for the cargo hoisting unit drives a single grooved spooling drum. The cargo hoisting unit is capable of the following operation:

1. A pull of 6,160 pounds at the drum gives the 3/4-inch diameter wire rope a travel of 120 feet per minute when handling a useful hook load of 10,000 pounds traveling at 60 feet per minute with a two-part purchase arrangement.

2. A pull of 295 pounds at the drum gives the wire rope a travel of 360 feet per minute when handling an empty hook traveling at 180 feet per minute with a two-part purchase arrangement.

3. A pull of 6,220 pounds at the drum gives the wire rope a travel of 120 feet per minute when handling a useful hook load of 5,000

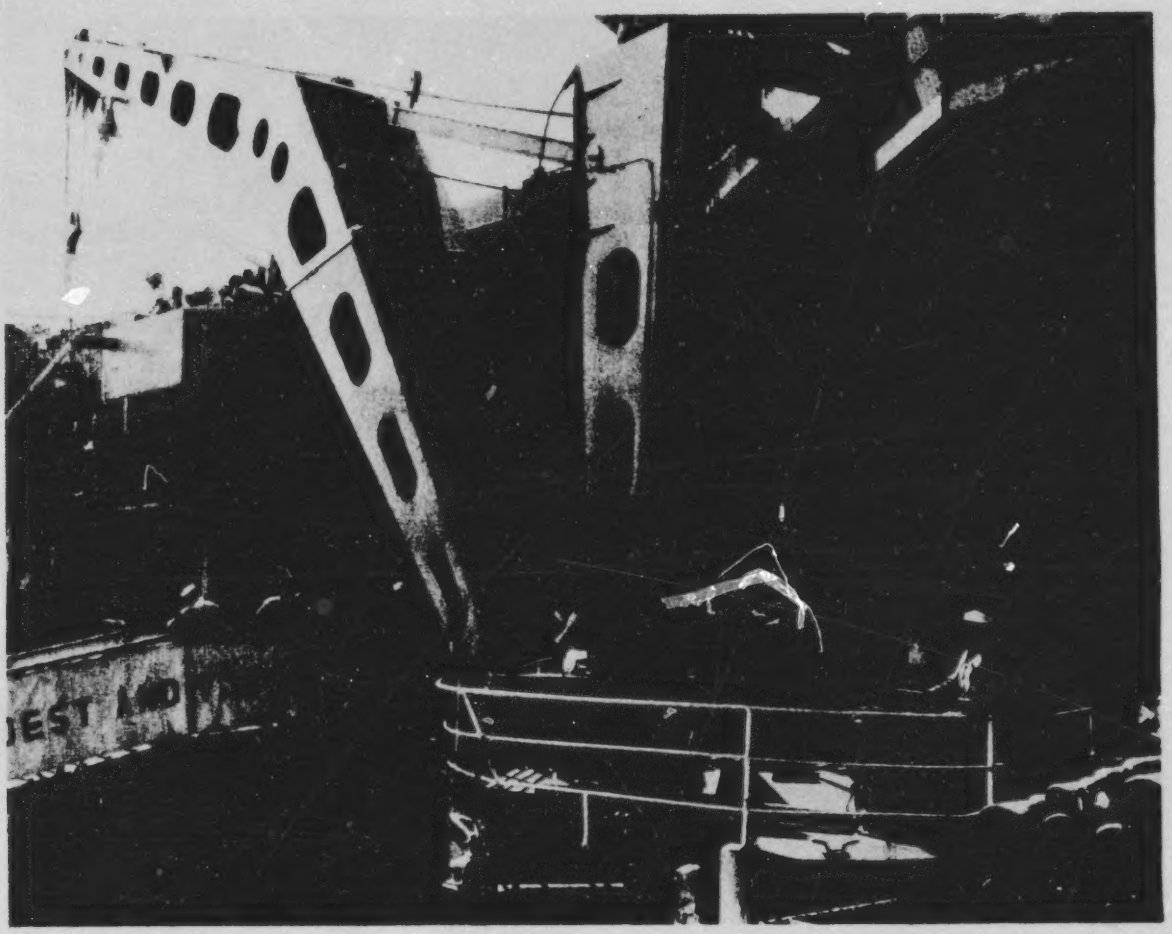

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Figure 2-8.—Shipboard aircraft crane.

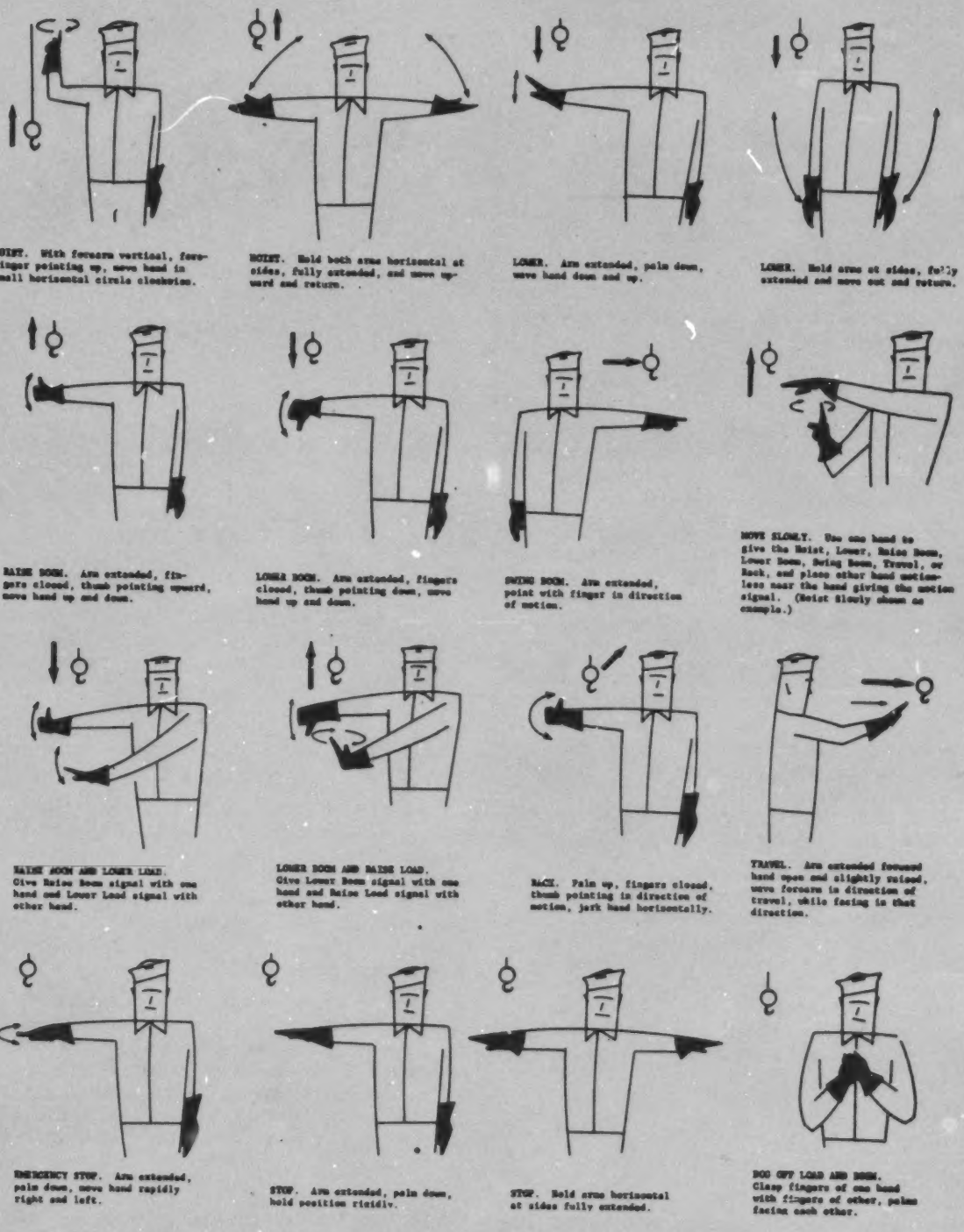
pounds traveling at 120 feet per minute with a single part purchase arrangement.

4. A pull of 565 pounds at the drum gives the wire rope a travel of 360 feet per minute when handling an empty hook traveling at 360 feet per minute with a single-part purchase arrangement.

The gear reducer for the rotating unit drives a pinion gear meshing with the main rotating gear. The rotating unit is capable of rotating the crane at a maximum rate of 1/2 rpm with a hook load of 50,000 pounds and the ship listing adversely 5 degrees.

The operator's controls for the aircraft, cargo, and rotating units are grouped on one control stand and are all operated from the operating platform of the crane. A more detailed discussion of electric hydraulic cranes may be found in NAVSHIPS Technical Manual. The ABH1 and ABHC are responsible for knowing the limitations and capabilities of the cranes in their charge.

In order to operate a crane safely and efficiently, a crane operator must be assisted by one or more crane signalmen. These signalmen must be located at appropriate vantage points which offer an unobstructed view to the operator. Since the operator and signalmen must function smoothly as a team, a practical means of visual communication is necessary. (See fig. 2-9.)


HOIST. With forearm vertical, forefinger pointing up, move hand in small horizontal circle clockwise.
HOIST. Hold both arms horizontal at sides, fully extended, and move upward and return.
LOWER. Arm extended, palm down, move hand down and up.
LOWER. Hold arms at sides, fully extended and move out and return.
RAISE BOOM. Arm extended, fingers closed, thumb pointing upward, move hand up and down.
LOWER BOOM. Arm extended, fingers closed, thumb pointing down, move hand up and down.
SWING BOOM. Arm extended, point with finger in direction of motion.
MOVE SLOWLY. Use one hand to give the Hoist, Lower, Raise Boom, Lower Boom, Swing Boom, Travel, or Back, and place other hand motionless near the hand giving the motion signal. (Hoist slowly shown as example.)
RAISE BOOM AND LOWER LOAD. Give Raise Boom signal with one hand and Lower Load signal with other hand.
LOWER BOOM AND RAISE LOAD. Give Lower Boom signal with one hand and Raise Load signal with other hand.
BACK. Palm up, fingers closed, thumb pointing in direction of motion, jerk hand horizontally.
TRAVEL. Arm extended forward hand open and slightly raised, move forearm in direction of travel, while facing in that direction.
EMERGENCY STOP. Arm extended, palm down, move hand rapidly right and left.
STOP. Arm extended, palm down, hold position rigidly.
STOP. Hold arms horizontal at sides fully extended.
DOG OFF LOAD AND BOOM. Clasp fingers of one hand with fingers of other, palms facing each other.

199.22

**Figure 2-9.—Standard hand signals for crane operators and signalmen.**

CAUTION: Cranes are to be operated only by authorized personnel who are thoroughly trained in the fundamental rules of crane safety.

## MOBILE CRANES

The ABH is concerned with the operation of both fixed and mobile cranes in the handling of aircraft. A fixed crane is one whose base is stationary although its boom is movable. The mobile crane has a wheeled chassis.

The mobile crane is an emergency vehicle primarily designed for use in aircraft salvage and rescue and is used both at shore stations and aboard ship.

The ABH responsible for directing the use of mobile cranes must have some knowledge of their operation and handling characteristics. Of vital importance is a knowledge of their lifting capacities and the boom positions at which these capacities are obtained.

Maximum performance of the mobile crane, including its operating equipment, is dependent upon the frequency and scope of the maintenance and preoperational checks rendered, plus the ability of the operator to properly operate the crane.

If any type of equipment deserves to be checked out top to bottom and given a thorough physical before using, it is the crane. If you are operating with defective equipment, you not only run the risk of dropping the aircraft; you also run the risk of dropping it on another expensive aircraft or on personnel. Check out the crane and equipment before it is used.

Even if you have been around this equipment for a while, and certainly if you are new to the equipment, there are a few general characteristics which deserve to be emphasized and which would be wise for you to keep in mind when working with and around mobile cranes. Personnel to whom the crane is assigned should become thoroughly familiar with the crane's technical manual prior to actual operation of the crane.

### C-25 Mobile Crane

The C-25 Mobile Crane (fig. 2-10) is a truck-mounted crane manufactured by the Oshkosh Truck Co. It has a lifting capacity of 20 tons, has six-wheel drive, and a top speed of 50 mph.

200.6

Figure 2-10.—C-25 Oshkosh Mobile Crane.

### NS-50/60 Mobile Cranes

The NS-50/60 Mobile Cranes are designed primarily to lift and carry crashed aircraft on the flight deck of an aircraft carrier, and are equally suitable for similar duty on shore stations for both aircraft landing areas or unpaved operational areas. See figure 2-11 for an illustration of the NS-50 Mobile Crane.

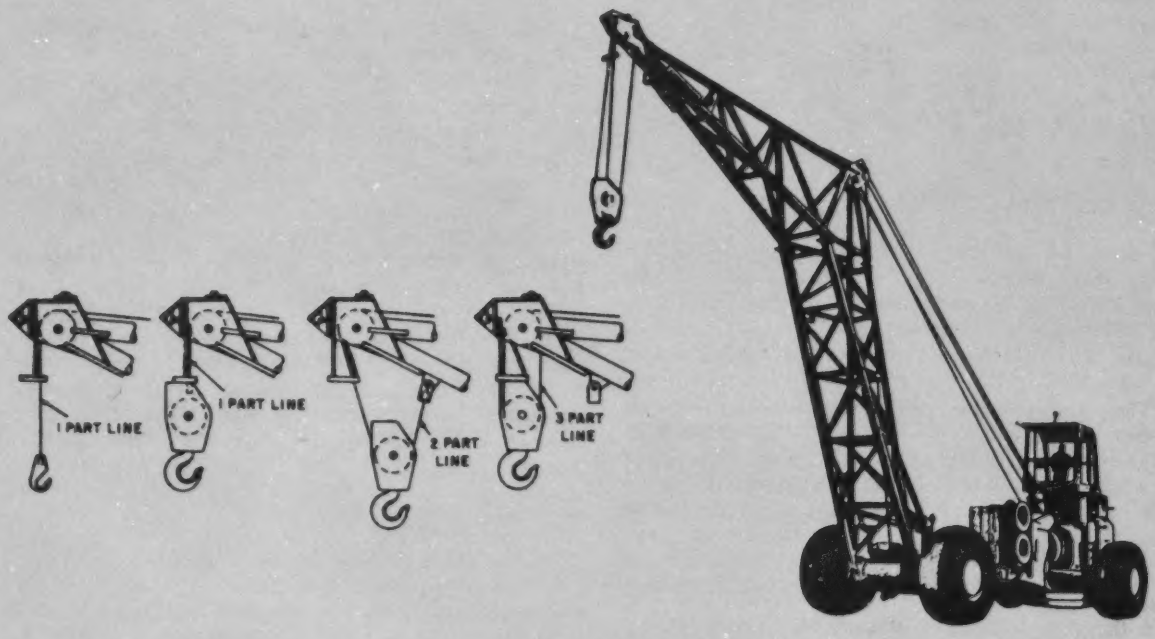
The NS-50 and NS-60 are quite similar in appearance mechanically and in operation, the basic difference being in the greater length of the boom and lifting capacity of the NS-60. For purpose of discussion, the NS-50 is described in this manual.

The NS-50 crane is a self-propelled vehicle, mounted on four electrically powered wheels.

Heavy-duty dc electric traction motors and gear reduction units built within the wheel rims provide motive power for the crane. Each wheel motor is equipped with multiple-disc type spring-loaded brakes for emergency stops and parking, while a regenerative electrical braking system is used for operational deceleration of the crane.

Gear motors power the boom, hook, and steering. Ac electric motors strategically located at the point of power application drive through gearboxes to power each crane function. Each ac motor is equipped with a multiple-disc spring-loaded brake that sets instantly when the motor's electrical power is interrupted. Restoration of the motor's electrical power automatically releases the motor brake.

Ac and dc generators, directly coupled to the diesel engine, supply current to the control



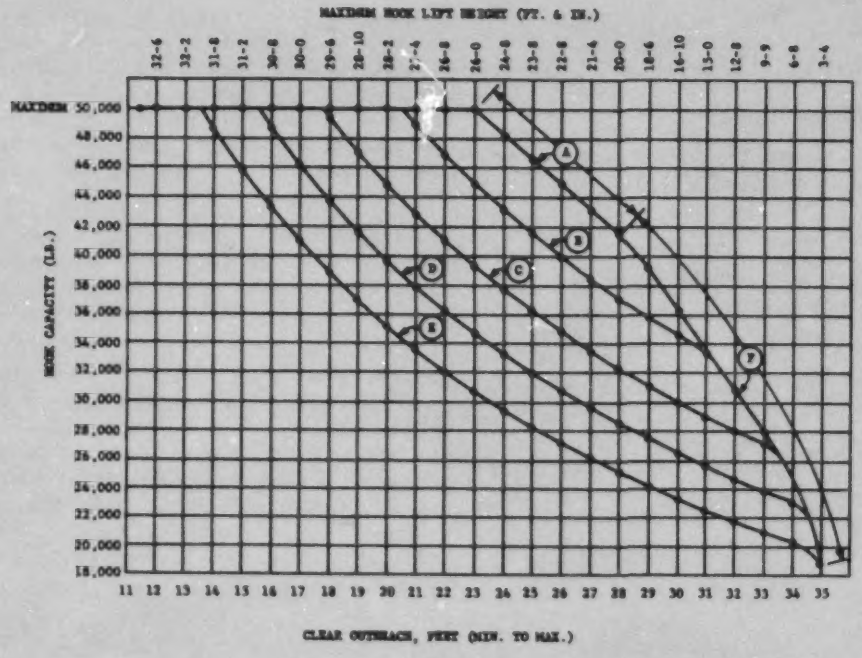




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Figure 2-11.—NS-50 Mobile Crane.

motors and to the dc drive motors. Fingertip switches on the operator's panel control the application of power to the ac motors. One control handle on the panel provides power and directional control of the electric wheels, while another gives the operator complete wheel motor braking control.

All normal operations required for maneuverability of the crane are managed from the operator's station. A remote control panel on the rear of the crane permits control of the hook and boom at a point near the load. The crane is 35 feet long overall without the boom. With the boom extended 23 feet, the overall length is 58 feet; and with the boom resting on the deck, the overall length is 71 feet. Overall height, with the boom extended 23 feet, is 31 feet 9 inches. With the boom resting on the deck the overall height is 17 feet. The width is 12 feet 4 inches. The turn radius is 30 feet. The crane is counterbalanced when lifting near-capacity loads by using counterweights. The crane should be operated with counterweight No. 1 in place during all hoisting operations.

The weight of this crane can be varied by the use of counterweights. There are four counterweights that can be installed singularly or in combination to vary the weight of the crane from 63,600 (no counterweights attached) to 83,746 pounds (all counterweights attached).

For load limits, the weight of this crane varies with the position of the boom and the amount of counterweight that is attached. For the lifting capacities, see figure 2-11.

Cable Reeving (NS-50)

The lifting capacity and speed of hook travel can also be changed by changing the hook line reeving. The different reevings are as follows:

1. Three-part line reeving gives 25 fpm hook travel and a maximum of 50,000 pounds of lift.
2. Two-part line reeving gives 50 fpm hook travel and a maximum of 33,000 pounds of lift.
3. One-part line reeving gives 75 fpm hook travel and a maximum of 16,600 pounds of lift, using the swivel hook and block assembly.
4. One-part line reeving gives 75 fpm hook travel and a maximum of 15,000 pounds of lift, using the light capacity hook.

The hook line may be reeved in four manners. (See fig. 2-11.)

The first method of reeving employs the 7 1/2-ton hook reeved with a single-part line; over the boom sheave, through the limit switch, dead ending and secured with the locking pin to the hook. The second method employs the 50,000-pound hook and a single-part line. It is reeved over the boom sheave, through the limit switch, dead ending and secured with the hook locking pin. The third method is a two-part line; reeved over the boom sheave, through the limit switch, around the hook sheave, dead ending on the boom structure, swinging dead end, secured to the dead end with locking pin. The fourth method is a three-part line; reeved over the boom sheave, around the hook sheave, over the second boom sheave, dead ending on the hook block and secured with locking pin. Boom luffing lines are reeved as a four-part line to the dead end of the main frame.

CAUTION: Reeve boom and hook lines to maintain not less than three wraps on their cable drums and at least two wraps around the boom dead ends on the yoke structure.

Each method of reeving allows the operator to employ the crane's hook at different capacities and hook speeds. Keep in mind that each crane has a maximum lift and reach rating. It is the responsibility of the supervisor/operator of the crane to make sure that the load does not exceed the crane's limits.

NOTE: When reeving any crane, defective sheaves must be replaced to prevent pinching and excessive wear to the wire rope.

Operation

Only qualified operators are to be used to operate cranes. The operator must understand the function and operation of each of the crane's instruments and controls. This knowledge is essential for the proper maintenance and operation of the machine. This information can best be gained by a study of the operation manual.

Most cranes have warning lights on the instrument panel to indicate an abnormal condition of the machine. Warning lights are used to indicate low air pressure in the brake

system, low engine oil pressure, and over-temperature of cooling systems and wheel drive motors. On some machines the light comes on when the component is operating normally, on others only when the component is malfunctioning.

Warning lights for the NS-50 are as follows:

1. Engine coolant—red—comes on when the coolant reaches 200° F.
2. Engine oil pressure—red—comes on when the oil pressure drops below 8 psi.
3. Drive wheel motors—amber—comes on when the drive wheel temperature reaches 290° F. When this light comes on, the snorkels that are used as an aid in cooling the wheel motor should be opened.
4. Drive wheel motors—red—comes on when the drive wheel motor reaches 340° F. The crane must be stopped when this light comes on.
5. The crane must be stopped when any red warning light comes on, and the malfunction must be corrected before any further operation.

When the crane is being maneuvered to pick up a crashed aircraft, watch the position of the crane wheels in relation to the aircraft. Most cranes must be fairly close to the aircraft if the hook is to be in the proper position. Personnel must be stationed so that they can give ample warning if any part of the crane looks as if it would hit the aircraft. For the lifting of certain aircraft there are only one or two positions where the crane can be if the hook is to be properly positioned.

Make sure that the hook is properly centered over the load to be lifted. Use small trial lifts in the beginning and be prepared to stop if the load tends to shift or swing.

When the crane is required to travel with a load, keep the load as close to the crane wheels and as close to the ground as possible. All stops, starts, and turns must be made very slowly to avoid swinging the load. When moving the crane with no load, the hook must be run up as close to the top as possible, or the hook must be lashed to the boom to keep it from swinging.

### Safety Precautions

As with all heavy equipment, precautions should be taken when operating or servicing cranes. Your safety as well as the safety of a fellow worker depends on it.

It is imperative that the operator understands the function and operation of each of the instruments and control switches on the instrument panel. This knowledge is essential for the proper maintenance and safe operation of the mobile crane.

Personnel assigned as operators of the crane must be fully qualified in the operation of the crane and be familiar with the local instructions regarding the crane's use.

Never leave the crane with the engine operating and make sure that all electrical switches are turned off when leaving the crane.

Keep the speed of the crane to a minimum. Make all starts and stops as smoothly as possible.

Check instruments frequently during crane operations. Any abnormal gage indication should be checked immediately and corrected before continuing the operation. The crane must be stopped as quickly as possible when any warning light comes on and the trouble corrected.

Cables should be kept tight, but not under severe strain when the crane is not in operation. Inspect all cables periodically for frayed or broken strands and replace when necessary. Always wear gloves when making this inspection to prevent injury to the hands.

When operating a crane from the remote control station, an operator must always be in the operator's cab.

Do not touch bare electrical connections or electrical cables if insulation is broken. Request the services of the maintenance electrician for performing all electrical checks and repairs.

## AIRCRAFT HOISTING SLINGS

Hoisting slings are used aboard aircraft carriers, as well as by shore stations, to aid in moving aircraft and equipment. Each military aircraft is equipped with lifting points for the attachment of the particular sling designed for use with that model of aircraft. Slings are sometimes used in place of jacks for performing aircraft maintenance and are commonly used to lift aircraft from the pier or barge onto the carrier (either onto the flight deck or elevator platform). They are also used for crash/salvage handling of aircraft.



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In that the load bearing cables, chains, or straps of hoisting equipment are subject to wear and deterioration, it is necessary that these components be thoroughly inspected and tested at frequent intervals. A complete visual inspection is required prior to each use, and proof-load testing must be carried out at least once a year as directed by NAVAIR 17-1-114, Handbook, Inspection and Testing of Lifting and Restraining Devices for Aircraft and Related Components.

The general procedure for inspecting slings prior to each use is as follows:

1. All dirt and foreign matter should be removed from the assembly to be inspected.

Cables must be inspected for corrosion, kinks, knots, slippage, loosening of fittings, fraying, stretching, or any other signs of failure. Of particular importance is the detection of a cable in which a kink has been pulled through in order to restraighten the cable. The resultant deformation, as shown in figure 2-12, is cause for immediate rejection of the cable.

The presence of 6 or more broken wires in any 9-inch length of cable or 3 broken wires in any one strand 3 inches in length is cause for replacement. If excessive corrosion is present, the cable must be replaced, regardless of the number of broken strands.

Chains used in slings must be inspected for stretching, wear, gouges, fractures, corrosion, kinks, and knots. Chains having more than a 5-percent stretch in any 5-link section must be discarded. Chains which show 25-percent wear in any individual link must also be discarded.

Terminals, lugs, shackles, plates, and other fittings must be checked for misalignment, wear, corrosion, loosening, slippage, fractures, etc. Inspect all bolt holes for elongation and stripped threads. In the case of cable terminals, the lay of the cable beneath the base of the terminal must be examined to ensure that the lay is undisturbed and that the individual wires are fitted tightly together.

2. When a fitting is found to be severely corroded, a glass bead type of blaster should be used to remove scales. The fitting must then be examined to determine the extent of deterioration. Fittings with severe pitting should be discarded. If fitting is found to be serviceable, it should then be cadmium-plated and examined by means of magnetic particle inspection.

3. Zinc-poured terminals must be inspected at the top for slippage of individual wires and for excessive depression in the zinc filling. Wire slippage in zinc may not exceed 1/32 inch, and zinc pullout from the base of terminal may not exceed 1/8 inch.

Proofloading of slings is normally accomplished at Naval Air Rework Facilities (NARF), and are static-tested at 1 1/2 times working loads of the sling. It is strongly recommended that a metal tag be securely attached to each sling assembly to reflect the following information:

1. Date of last proofload test.
2. Due date for the next test.
3. Name of testing activity.

NOTE: The use of aircraft hoisting slings is discussed in chapter 4 of this Rate Training Manual.

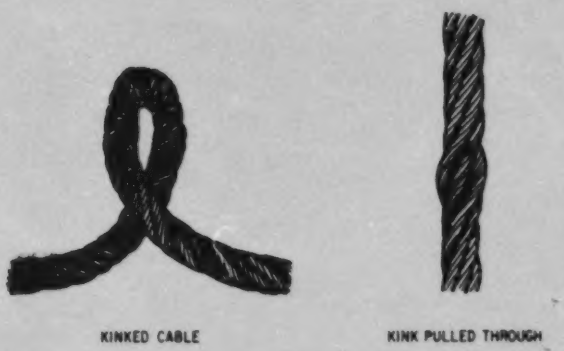


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Figure 2-12. — Cable damage resulting from a pulled through kink.

SAFETY

Never stand or permit personnel to stand under or near a suspended load or tensioned cable/sling whether testing or during actual hoisting of a load/aircraft. Avoid makeshift repairs of hoisting equipment. Whenever a component is found to be faulty, it must be replaced with a new component designated for

that specific purpose. Frequent failures have been caused by using a bolt, pin, or other part of the wrong size or strength as a replacement for a faulty or missing component. After replacment of the faulty part, the entire assembly must be proofload tested.

## TOW BARS

There are two classes of tow bars, those designated as universal and those designated as special. The special tow bars are those designed for use with only one type of aircraft. The universal tow bar, NT-4, is designed to tow and position all carrier-based aircraft.

The Universal Aircraft Tow Bar, Model NT-4 (fig. 2-13), is the type of tow bar most commonly used by the Navy today. It is designed to provide for the nose tow of aircraft, employing four different sizes of nosewheel axle tow holes. The NT-4 is also designed for towing aircraft provided with fuselage and landing gear tow rings. Attachment is dependent on the aircraft being towed and is accomplished by either axle pins or hooks.

This tow bar is provided with a securing chain that will allow the tow bar to spread 25 inches thereby accommodating the maximum nosewheel axle length for carrier-type aircraft. By detaching the chain from one side of the split tow bar, the tow bar may be opened as required for fuselage tow.

The tow bar is made of aluminum alloy, is 15 feet long, weighs 135 pounds, and is designed to handle aircraft with a maximum gross weight up to 90,000 pounds.

Most carrier aircraft have provisions for towing from the nosewheel axle. In view of the fact that the aircraft to be towed have been provided with four different sizes of holes, ranging from 3/4-inch diameter to 2 1/2-inch diameter, the tow pins have been sized to suit.

Before attaching the tow bar to the aircraft nosewheel, the proper size pin must be selected.

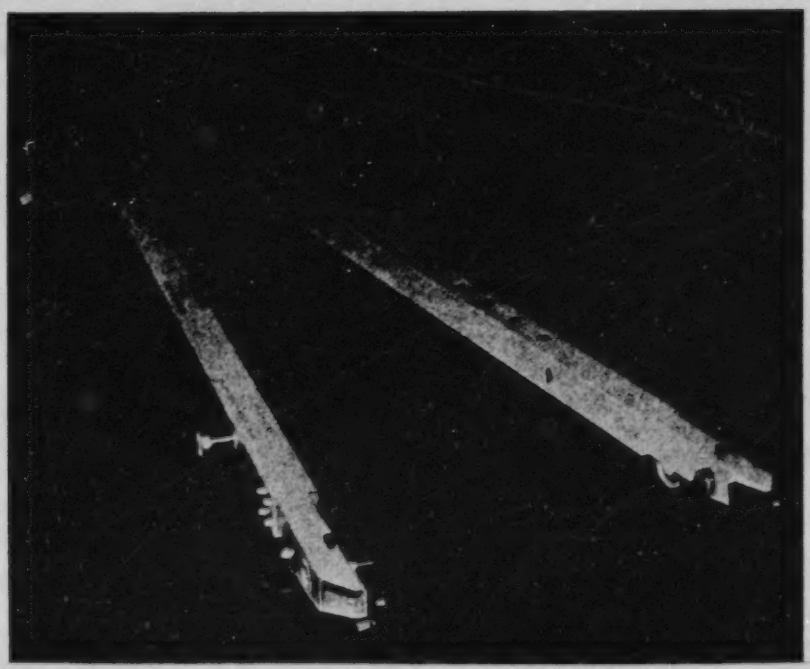

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Figure 2-13.—NT-4 Universal Aircraft Tow Bar.

The axle pins are held in the tow bar by quick-release pins. After selecting the proper size, engage the pins in the towing holes of the aircraft. With the chain through the movable rail, engage the chain in the slot and tighten the chain by turning the knob (handtight) on the fixed rail.

CAUTION: Be sure that the chain is tight and under tension.

For aircraft that have towing rings on the fuselage or on the landing gear, hooks are provided on the tow bar. When engaging the hooks in the towing rings, make sure that the

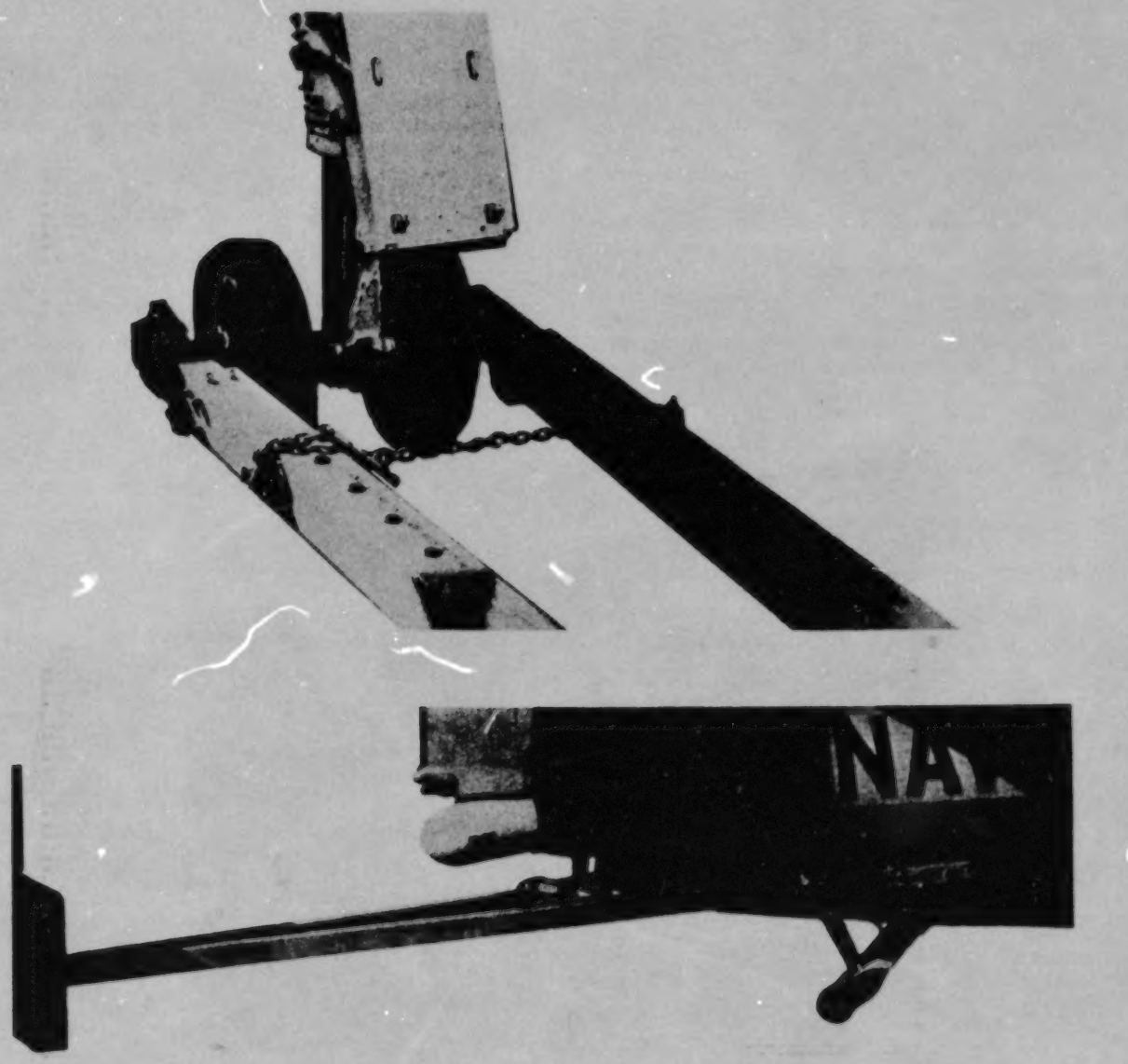

Figure 2-14.—NT-4 attached to an S-2F for nosewheel or fuselage towing. 200.8

spring-loaded pin is completely closed. When using the hooks, the axle pins should never protrude on the inboard side of the tow bar and the chain should be stowed on the fixed rail. The axle pins can be stowed in the tow bar by installing them with the small tapered end flush with the inboard side of the A-3 lug. Figure 2-14 shows an NT-4 attached to a S-2F aircraft.

When towing the tow bar without attachment to an aircraft, the axle pins should be installed with the small tapered end flush with the inboard side of the A-3 lugs and the chain engaged in the slot and stowed.

Special tow bars are those designed by the aircraft manufacturer for a special purpose, or to tow an aircraft that has special handling characteristics. An example of this type of bar is the one designed for use with the UH-34C helicopter. (See fig. 2-15.)

This tow bar is used to properly steer the helicopter whenever land or shipboard towing is necessary. It is installed on the auxiliary landing gear for towing and steering purposes.

The P-3A aircraft comes under a special category in that it must be towed or steered only by a special tow bar made by the aircraft manufacturer. This tow bar is designed so that when it is installed on the nosewheel landing gear, it unlocks the aircraft steering system. When this bar is removed, the aircraft steering system lock is automatically restored.

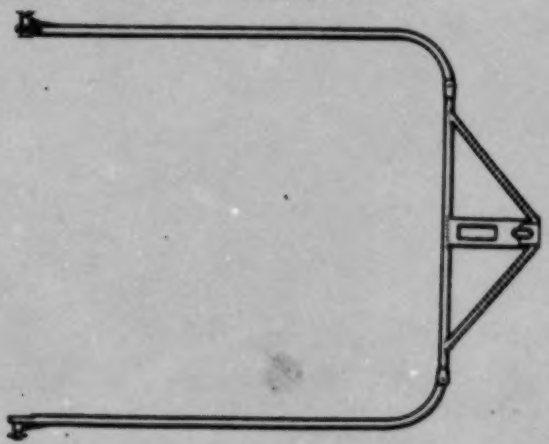

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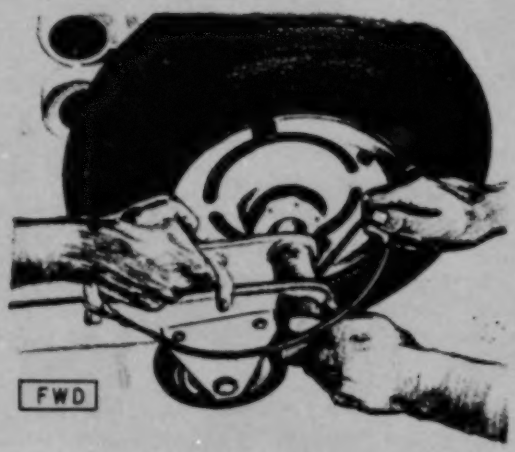
Figure 2-15.—Special tow bar for the UH-34.

There are two special tow bars for the A-6A; the rearward towing tow bar and the forward towing tow bar. (See fig. 2-16.)

The rearward tow bar for the A-6A is attached to a special fitting on either main landing gear. The tow tractor is positioned alongside the aircraft and tows from that position. A tiller bar or the forward tow bar must be attached to the nosewheel for steering purposes during this operation.



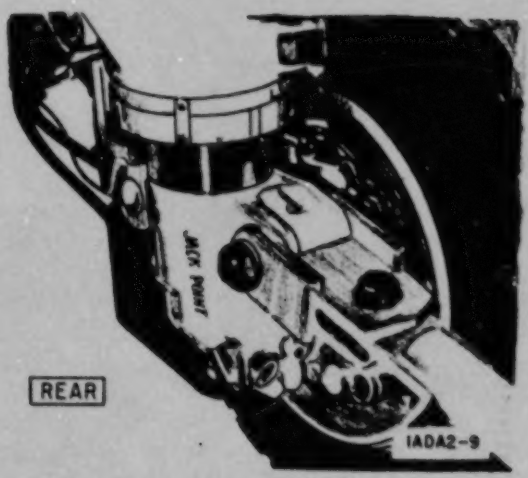




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Figure 2-16.—Special tow bar for the A-6A.

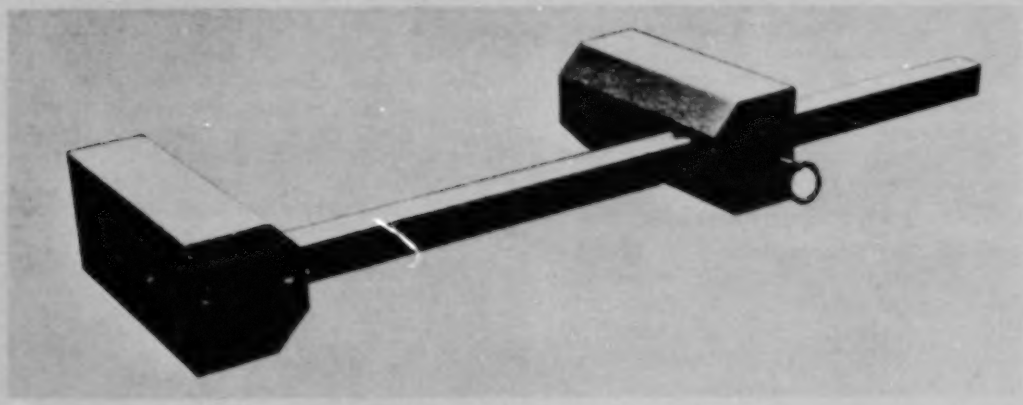

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Figure 2-17.—MWC-2 Universal Wheel Chock.

NOTE: Do not exceed 2 mph during rearward towing of the A-6A. Use the aircraft brakes sparingly during towing to prevent damage to the nose and the main landing gears.

Information on the tow bar(s) for any given aircraft can be found in the general information section of the Maintenance Instructions Manual for that aircraft.

## AIRCRAFT CHOCKS AND TIEDOWNS

Whenever an aircraft is not being moved, the main landing gear wheels should be chocked. The chocks may be universal chocks designed to be used with most carrier-based aircraft or special chocks made up by the squadron operating the aircraft.

The universal chock used by the Navy is the Model MWC-2 Universal Wheel Chock. (See fig. 2-17.) This is an all-metal chock that is adjustable to fit any main landing gear wheel up to 45 inches in diameter.

Special chocks are made and used where standard or universal chocks are of insufficient size. At times, it may be necessary to make chocks for use when there are insufficient standard chocks for the number of aircraft aboard. These chocks can be made from many different materials; for example, wood and line, all wood, or metal tubing and chain.

## TD-1A AIRCRAFT TIEDOWN

The TD-1A and the holdback type of tiedown use chain as part of the tiedown. The TD-1A tiedown device (fig. 2-18) is used to secure parked aircraft to the deck ashore and afloat. A minimum of four units is used for small aircraft.

To prepare the unit for use, the adjustable hook is extended by rotating the tensioning grip in the opposite direction to the arrows on it. The hook on the chain is inserted in the deck fitting; the hook on the unit is fitted on the aircraft. This tiedown has a capacity of 10,000 pounds and weighs about 12 pounds.

199.16.1

Figure 2-18.—TD-1A All Purpose Tiedown.

Allowing a small amount of slack in the chain, a link is pushed down into the chain pocket until the chain lock snaps into place. If there is too much slack in the chain, another link can be chosen by pushing the chain lock toward the chain pocket, lifting the chain out, and choosing another link. The tensioning grip is then rotated in the direction of the arrows until the desired tension is reached.

To release, the release lever is pulled up and back in the direction indicated by the arrows.

The TD-1A chain has an oversize link on the end opposite the hook so that chains may be used in series when a longer tiedown is needed.

The holdback type of tiedown (fig. 2-19) is used to secure the aircraft to the deck while the engine is being run up to full power for check and adjustments.

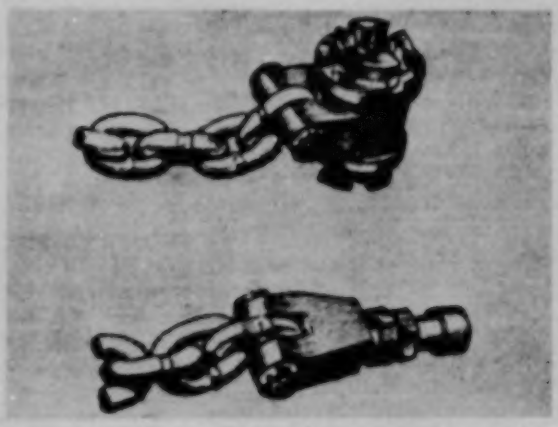

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Figure 2-19.—Holdback tie down.

The holdback type of tiedown consists of a coupler, chain, and a deck fitting. The coupler adapts to the fitting on the aircraft used for the catapult holdback tension bar. The coupler is positive locking on the aircraft fitting. The chain is made of welded links and attaches to the coupler and deck fitting by removable shackles. The deck fitting assembly permits 360 degrees horizontal travel around the deck and 0 to 45 degrees vertical angle from the deck. The deck fitting assembly adapts to the fourbar deck fitting and the fivebar deck fitting.

This tiedown is about 10 feet long and weighs about 102 pounds. The design capacity is 90,000 pounds from 0 to 45 degrees of angle. The fivebar deck fitting has a design strength of 36,000 pounds.

There is also a full power turnup tiedown for the A-5A. This tiedown uses the same deck fitting as the holdback tiedown, but uses two cables with hooks for attaching to the main landing gear towing rigs of the aircraft.

Temporary tiedowns may be made of hemp line or nylon straps. Cargo-type nylon securing straps are sometimes used by helicopter crewmen as an initial tiedown when the helicopter touches down. These straps are light, easy to fasten, and quick to tension. They are designed for light loads of 1,000 to 1,200 pounds.

The weight of present day carrier aircraft has increased to the point where they can no longer be adequately secured with line alone; however, the ABH should have a good working knowledge of both nylon and manila line, as they are frequently used for the securing of gear and equipment and the temporary securing of aircraft aboard ships. Handling of line and the thumb rules for safe working loads are covered in detail in ABH 3 and 2, NAVEDTRA 10300 (Series).

Detailed instructions concerning aircraft handling and securing equipment may be found in NAVAIR 17-1-537, Technical Manual, Operation and Service Procedures, Aircraft Handling and Securing Equipment. It is recommended that this manual be placed and maintained in the ABH technical library.

## SCREENING DEFECTIVE EQUIPMENT

The failure of handling equipment during flight operations both ashore and aboard ship can pose many problems for the ABH. At times this can seriously affect the safety of the operation. The first class and chief must know enough about repair procedures to estimate the time the equipment will be out of commission and its effects on the safety of operations.

Whenever a piece of equipment fails, there are several questions that should be answered.

1. What operations will this equipment affect by being unavailable?
2. What can be used in its place?

3. What division or department is involved or who is qualified to effect the repair?

4. How long will it take to repair the equipment? (If it is your responsibility to repair the equipment, you will need to know how many men will be needed.)

5. Are spare parts available and if they are not, how long will it take to get them?

6. Is the equipment available to perform the repair?

There are numerous sources where information can be found. The Maintenance Requirements Cards as well as the technical manual for each tow tractor and mobile crane should give the time required, the equipment or tools, and the number of men needed to make the repair. The NAVSHIPS Technical Manual gives detailed repair procedures for most of the shipboard machinery, piping systems, deck, etc.

Frequent inspections should be made during the performance of the work as well as after completion. The supervisor's inspection should provide affirmative answers to the following:

1. Is the work done according to the current directives?

2. Do technical materials used conform to specifications?

3. Is the job complete in all respects?

4. Does the workmanship measure up to desired standards?

The most effective repair procedure is prevention. A thorough maintenance program continuously carried out, and proper operating procedures adhered to, not only promotes safety, but also prevents most equipment failures.

## CORROSION CONTROL

In recent years more equipment is being made of metals other than steel or in combinations of several different metals. Tow bars, tow tractor parts, flight decks, chocks, and many parts of ships' structures are being made of aluminum. Since the introduction of steel ships, rust has been, and still is, one of the major problems of maintenance. With the introduction of aluminum and other metals, more problems have been added to corrosion control.

Corrosion may take place over the entire surface of a metal from chemical reaction with the surrounding environment, or it may be electrochemical in nature between two metallic materials or two points on the surface of the same alloy, which may differ in chemical activity. The presence of moisture is essential in both types of attack. The most familiar example of corrosion is the rusting of iron or steel.

Corrosion of aluminum alloy is evident as white or gray powdery deposits on the metal surface. The condition is first indicated by the powdery residue deposited in the area of contact, later by the pitting and scarring of the aluminum surface, and finally complete deterioration of the aluminum in the area.

Corrosion endangers the equipment by reducing the strength and changing the mechanical characteristics of the metals used in its construction. Materials are designed to carry certain loads and withstand given stresses as well as to provide an extra margin of strength for safety. Corrosion can weaken the structure thereby reducing or eliminating this safety factor.

There are many factors that affect the type, speed, cause, and the seriousness of metal corrosion. Some of these corrosion factors can be controlled; others cannot. Preventive maintenance factors such as inspection, cleaning, and painting and preservation are within the control of the operating activity.

When corrosion of equipment or structure has been discovered, the first step to be taken should be the safe and complete removal of the corrosion deposits or replacement of the affected part. Which of these actions to be taken depends upon the degree of corrosion, the extent of damage, the capability to repair or replace, and the availability of replacement parts. Any part which has been damaged by corrosion should be replaced if continued use is likely to result in structural failure. Areas to be treated for corrosion deposit elimination must be clean, unpainted, and free from oil and grease. Chips, burr, flakes of residue, and surface oxides must be removed. However, care must be taken to avoid removing, at the same time, too much of the uncorroded surface metal. Corrosion deposit removal must be complete. Failure to clean away surface debris permits the corrosion process to continue even after refinishing the affected areas.

After the corrosion has been removed the extent of damage must be assessed. It is at this point that the determination is made to repair or replace the affected part or to perform a corrosion correction treatment. This treatment

involves the neutralization of any residual corrosion materials that may remain in pits and crevices, and the restoration of permanent protective coatings and paint finishes.

Control of corrosion can be accomplished by maintaining a dry environment through the use of suitable moisture barriers or drying agents.

Complete technical information may be obtained by reference to Aircraft Weapons Systems Cleaning and Corrosion Control, NAVAIR 01-1A-509; and Preservation of Naval Aircraft, NAVWEPS 15-01-500; and to the manufacturer's instructions furnished with various proprietary materials.

SAFETY

When maintaining or working with equipment, there is one rule that must be strongly stressed: SAFETY FIRST. Whether you are working in the shop, on the line, or on the flight or hangar deck, there are prescribed safety procedures that should be followed. It is a must to be aware of the many dangers that are associated with this type of work.

Because of the possibility of injury to personnel, and the possible damage to material, all repair and maintenance work should be done only by authorized and assigned personnel.

The ABH1 and ABHC should be concerned with the inspection of work areas, tools, and equipment to detect potentially hazardous and unsafe conditions and take appropriate corrective action.

Safety is an area in which the ABH's responsibility increases as he advances in rating. An ABH1 or ABHC must possess the ability to interpret safety directives and precautions. The First Class or Chief must know and observe all safety precautions for the equipment he uses and the work he does.

The importance of interpreting the safety rules and regulations, and either giving your men instructions or publishing them in written form, cannot be stressed too much. However, the indoctrination of your men in safety precautions and techniques is an integral part of the safety program.

# CHAPTER 3

# AIRCRAFT HANDLING

This chapter covers aircraft handling on naval air stations, aboard aircraft carriers, and LPH/LPD ships.

## NAVAL AIR STATIONS

At naval air stations the ABH1 or ABHC may be assigned to the operations department. The term operations, as used here, refers to routine operations concerned with regulating the arrival and departure of aircraft at a naval air station, and not to military tactics. Therefore, senior ABHs may be assigned as flight line leading petty officers.

## FLIGHT LINE

The air station line is under the operations department. The line division is responsible for the servicing, loading and unloading, and checking for operational readiness of all aircraft that may be assigned to the naval air station and those transient aircraft that may require these services.

The organization of a naval air station line varies with the number and type of aircraft assigned to the air station. Personnel in the division are assigned as plane captains, taxi signalmen, and equipment operators. On small air stations the men in the division may be required to perform all of these duties. Men from maintenance shops may also be assigned to perform specific checks and other operations.

The line division officer is responsible for the operation of all aircraft and handling equipment on the line and works directly under the operations officer.

The flight line division is responsible for accomplishing the following functions:

1. Line maintenance for assigned aircraft. Line maintenance includes the daily inspections, adjustments, servicing, correction of minor discrepancies, and troubleshooting of aircraft being prepared for flight.
2. Performing line-servicing functions for transiting aircraft.
3. Operating air terminal facilities.
4. Scheduling administrative and proficiency flights.
5. Recommending personnel for assignment as plane captains, directors, equipment operators, and cargo handlers.
6. The security and proper ground handling of aircraft and associated support equipment.
7. Recommending changes in methods and techniques to promote maximum ground safety, safety in flight, and operational readiness of assigned aircraft and associated support equipment.

The leading petty officer in charge is the assistant to the division officer in carrying out the functions of the line. He must keep himself and the line division officer informed of the status of all the aircraft and handling equipment, and any unusual conditions which may exist.

Some of the major duties of a leading petty officer in charge of a line are included in the following list:

1. Direct and spot aircraft on and off the flight line.
2. Ensure that aircraft are spotted in accordance with a given operational plan (if required).
3. Ensure that adequate firefighting equipment is available and properly manned when starting aircraft.
4. Ensure that aircraft are preflighted and ready to go prior to scheduled flights.
5. Maintain status reports on all aircraft assigned to the line.
6. Ensure that sufficient auxiliary power units are available for starting aircraft.
7. Maintain flight records as required.



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8. Ensure that aircraft are fueled and defueled properly, observing all applicable safety precautions.
9. Enforce all safety precautions applicable to flight line operations.
10. Direct the movement of aircraft away from the scene of fires.
11. Ensure that aircraft are secured properly.
12. Ensure the cleanliness of the line, equipment, and spaces.
13. Train and supervise plane directors.
14. Perform other duties as may be assigned by the department head.

In addition to the above duties, the first class or chief ABH assigned to an air terminal must have a thorough knowledge of aircraft cargo loading procedures and weight limitations of the aircraft concerned.

Personnel assignments are made by the division chief, and all personnel matters are submitted through him to the division officer.

Plane Captains

The plane captain is responsible for the material condition of the particular type of aircraft his unit or squadron is utilizing. He should be familiar with the general features of the aircraft and have a practical knowledge of the airframe and powerplant. His knowledge should be such that he will be able to assist in all phases of required routine engine and airframe periodic checks.

Taxi Signalmen (Plane Director)

Standard taxi signals are used by all branches of the Armed Forces so that there will be no misunderstanding when a taxi signalman of one service is signaling a pilot from another. These signals must be definite and precise to eliminate any possible m'sunderstanding and to inspire the pilot's confidence in the signalmen. All men assigned to the line should be qualified as taxi signalmen. When the line crew is large, some men may be assigned as taxi signalmen as their primary duty.

Any time an aircraft is to be taxied from the line or is returning to the line for spotting, it must be directed by one or more taxi signalmen as necessary.

The taxi signalman should assume and maintain a position where he can see the pilot's eyes at all times. If it is necessary for him to lose sight of the pilot's eyes in changing positions, or for any other reason, he should signal the pilot to stop until he has taken up his new position.

The taxi signalman has a definite position to maintain when directing aircraft, calculated to give him all possible advantages. His position, when directing single-engine aircraft, should be slightly ahead of the aircraft and in line with the left wingtip. An alternate position, in line with the right wingtip, may be used when it is necessary to clear obstructions.

When directing aircraft with side-by-side seating, such as is found on multipiloted aircraft, his position is forward of the left wingtip. He has no alternate position since the pilot on a multipiloted aircraft sits on the left-hand side of the cockpit. When directing multipiloted aircraft in obstructed areas, an assistant taxi signalman may be used on the right wingtip. The assistant taxi signalman will signal the aircraft taxi signalman on the left wingtip. The taxi signalman must always be in a position to see the assistant taxi signalman and the pilot's eyes.

Aircraft being taxied on land within 25 feet of obstructions must have a taxi signalman at each wingtip. If any obstruction is present on one side only, a man at that wingtip is required. Aircraft must not be taxied at any time within 5 feet of obstructions. Aircraft being taxied on water must not be taxied closer than 50 feet to obstructions except in mooring or docking procedures or when dictated by the nature of the mission. Extra precaution is necessary when directing aircraft at night. The taxi strip and parking area should be inspected for workstands and any other mobile equipment which can damage the aircraft.

In directing an aircraft that is taxiing from the line, the director should remain in control of the aircraft until it is clear of the other aircraft or obstructions in the spotting area.

Equipment Operators

A fully qualified petty officer should be charged with the supervision of the equipment operators and line equipment. The type and amount of aircraft handling and servicing equipment on the line vary with the type and number of aircraft that may be assigned to the naval air station. Operators of all self-propelled vehicles must possess a valid government driver's license (SF-46) and have attended a formal course of instruction on aircraft support equipment (ASE).

OPNAV 3500.26 (Series) gives detailed instructions on the licensing of ASE operators.

The handling equipment may be one or more of the types discussed in chapter 2 of this training manual. Detailed information on the equipment required for handling and servicing can be found in the General Information and Servicing section of the Maintenance Instructions Manual for the respective aircraft. This manual also gives the handling characteristics and the securing equipment requirements and procedures for the aircraft.

Operators should be aware of all safety precautions and vehicle operating instructions issued by the commanding officer of the naval air station and higher authority.

## TOWING AIRCRAFT

Towing aircraft can be a hazardous operation, causing damage to the aircraft and injury to personnel, if done recklessly or carelessly. The following paragraphs outline the general procedure for towing aircraft; however, specific instructions for each model of aircraft are detailed in the General Information section of the applicable Maintenance Instructions Manual and should be followed in all instances.

Most naval aviation activities issue specific instructions concerning aircraft towing. These instructions usually contain the composition of the tow crew, tow tractor speed, and various other instructions concerning local conditions. These instructions must be complied with.

Aircraft are generally moved by a tow crew. The crew is usually composed of a tractor driver, plane captain, one man to watch for clearance at each wingtip and the tail, and a qualified director.

The man assigned to operate the brakes must be thoroughly familiar with the particular type of aircraft. His main function is to operate the brakes in case the tow bar should fail or come unhooked. He must also be familiar with the operation of various systems such as the ejection seat, power canopy, wing fold, and the safety precautions associated with each.

The men assigned to observe the wings and tail should proceed at their assigned stations as the aircraft is being towed. It is the responsibility of these men to keep sharp lookout for obstructions and signal the tractor driver in time to prevent collisions.

Only qualified personnel should attempt to tow an aircraft. Driving a tow tractor requires specialized training as well as a valid Navy driver's license.

When towing an aircraft, the towing vehicle speed must be reasonable, and all persons involved in the operation must be alert. Only reliable, competent personnel should be assigned to operate the tow tractors. When the aircraft is being towed, the brakes of the tractor should not be relied upon to stop the aircraft. The man in the cockpit should coordinate the use of the aircraft brakes with those of the tow tractor.

CAUTION: Before towing an aircraft, ensure that all landing gear ground safety locks are installed. These ground safety locks are pins and clamps used to ensure that the landing gear does not retract accidentally while ground handling the aircraft.

Aircraft are either towed by the fuselage, nosewheel, or the main landing gear, depending on the type of aircraft or the area over which the aircraft is to be towed. Many aircraft are provided with nosewheel steering; therefore, the cockpit steering system should be disengaged if possible when towing by means of the nosewheel.

The universal tow bar may be used to tow aircraft from rings mounted on the fuselage or landing gear. The tow bar is secured to these rings by means of hooks which are mounted on the ends of the bars. A spring-loaded safety pin secures the hooks in the rings.

Special tow bars are designed to be secured to the aircraft in various ways. The information contained in the applicable Maintenance Instructions Manual should always be followed when attaching special tow bars to an aircraft.

## SPOTTING AIRCRAFT

It is the responsibility of the ABH assigned to the line crew on an air station to direct and spot aircraft on the line. Sometimes the spot will be painted on the ramp, but in many cases the director will have to be familiar with the area so he can spot the aircraft in such a manner as to facilitate engine turnup, taxiing, or towing without materially endangering other aircraft on the line, and for securing aircraft on the parking ramp.

Incoming aircraft should be met at the edge of the spotting area and directed to the appropriate spot. Transient aircraft often require assistance from the runway to the spotting area. This is accomplished by the use of the follow-me jeep or other appropriate vehicle. The vehicle meets the aircraft at the end of the runway or an intersection to the runway and leads it to the spotting area.

CAUTION: All vehicles entering upon or crossing runways must get radio or visual clearance from the control tower before entering or crossing. Visual signals are used if radio communication is not possible.

An aircraft can be spotted on the flight line under its own power, by use of a tow tractor, or manually by pushing. Regardless of the method used to spot the aircraft, a qualified man must be in the cockpit to operate the brakes.

The position of the taxi signalman during spotting is the same as for taxiing. He must be able to see the eyes of the man in the cockpit at all times.

When spotting aircraft at night, extra precautions must be taken to ensure that the parking area is clear of workstands and other equipment. Assistant taxi signalmen should be used to ensure that the path is clear and there is no danger of hitting other aircraft or obstructions.

When the aircraft is spotted in its proper position, the brakes should be applied and held until the main landing gear wheels are chocked.

## AIRCRAFT TIEDOWN

The tiedown of aircraft is another very important part of ground handling. Aircraft ashore on naval air stations are chocked, and then tied down on concrete parking areas equipped with fittings called pad eyes. The aircraft to be tied down is spotted in the parking area in the best position for full utilization of the pad eyes. The aircraft may be tied down with cable tiedown reels, chain-type tiedown, manila line, or a combination of all.

When tying down aircraft, the expected weather conditions will determine how the aircraft should be secured. In normal weather the NORMAL TIEDOWN PROCEDURE is used; when heavy weather is anticipated, the HEAVY WEATHER TIEDOWN PROCEDURE is used.

Since the method of securing and tiedown procedures vary on different types of aircraft, refer to the applicable Maintenance Instructions Manual for the proper tiedown procedures.

### Securing of Aircraft

When an aircraft is in a position on the line, chocks should be placed ahead of and behind the wheels to keep the aircraft from rolling in either direction. Each aircraft should be grounded with a wire so that static electricity on the aircraft's surface flows off to the ground without causing sparks. Sparks caused by static electricity can cause a serious fire or explosion. Next, see that the tailwheel or nosewheel lines up with the direction of the aircraft. Then lock the wheel in position. Secure the aircraft to the ground with tiedown lines. Tiedown rings on the wings and a shackle on the tail are provided for this purpose. Pad eyes or stakes are used as hitching posts. If stakes are used, the corkscrew type furnishes the greater security. Plain metal stakes of angle iron or even wooden stakes are suitable when other types are not available. (See fig. 3-1.)

Cables are best for securing landplanes, although manila lines may be used in an emergency if sufficient slack is allowed for shrinkage if the line becomes wet from rain or night dew. Chain tiedowns are used in securing aircraft ashore as well as afloat. The next step in a tiedown operation is to hook the cable or chain to the ring in one wing, then to the pad eye or stake ring. Each wing, and finally the tail, is then secured. When high winds threaten, the cables or chains and anchorages are doubled, and the aircraft control surfaces are lashed in the neutral position with battens. In exceptionally rough weather, it may be necessary to lash spoiler boards across the leading edges of the wing to break up the smooth flow of air over the wing surfaces. A parking harness is used to secure the pilot's controls. A type of parking harness, consisting of wires with padded midsections and S hooks at the ends, is shown in figure 3-2.

In some aircraft the control surfaces can be locked in the neutral position by a control lock in the pilot's compartment. Detailed procedures for securing each type of aircraft can be found in the Maintenance Instructions Manual for the particular type of aircraft being serviced.

## FIREFIGHTING EQUIPMENT

The ABH1 and ABHC assigned to flight line duty should prepare himself for possible emergencies by becoming thoroughly familiar with the various types of firefighting equipment available on the line.

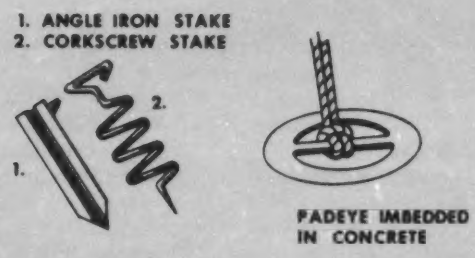


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Figure 3-1. — Securing stake.

Experienced crash crews and fire crews are always readily available; however, the need for the services of the fire crews can, in many cases, be avoided by the prompt and efficient use of firefighting equipment available at all times on the line. It is of the utmost importance that every man working on the line be familiar with the location and use of the firefighting equipment.

Standard color codes are used for visual identification of the fire extinguishers. The use of the standard color code for the extinguishers promotes greater safety, lessens the chance of error, confusion, or inaction in time of emergency, and also provides identification of the flight line fire extinguishers from building fire equipment.

The type of extinguisher, together with class of fire it will extinguish, must be painted on a 6-inch color band. The letters should be black and at least 1 inch in height.

The 6-inch band around the top of the extinguisher should be painted as follows:

Carbon dioxide ($CO_2$) . . . . . yellow
Foam type . . . . . silver or white
Purple K Powder . . . . . purple

Carts for handling the 50-pound extinguisher bottles should be painted the same color as the extinguisher band. The containers or holders for the other fire extinguishers located on the line may also be painted the same color as the extinguisher band.

The station fire chief is responsible for the proper distribution, maintenance, and inspection of fire extinguishing equipment provided for flight line operation.

The line chief under the station fire chief is responsible for the following:

1. Ensure that fire protection measures are provided for all aircraft undergoing maintenance or overhaul on the flight line or parking area.

2. That all line personnel engaged in duties involving aircraft operation be fully trained in fire prevention, fire protection measures, and the use of fire extinguishing equipment.

3. Ensure that a sufficient number of properly charged extinguishers are maintained for replacement while flight line extinguishers are being serviced.

4. Require a daily inspection of all line fire extinguishing equipment.

Carbon dioxide ($CO_2$) bottles are the most common fire extinguishers used on the line. These bottles are supplied in sufficient quantity to handle any small fire started on the line.

An aircraft should never be fueled, defueled, nor have its engines started without having one or more men standing by with a $CO_2$ bottle.

Some aircraft carry one or more small $CO_2$ bottles. These bottles are intended for use in flight and should never be used in ground operations except in an extreme emergency. In the event they are used, the proper personnel must be notified so that they may be replaced prior to the aircraft's next flight.

NOTE: Twinned Agent Units (TAU-2) are provided and should be standing by for immediate use during all aircraft hot refueling operations.

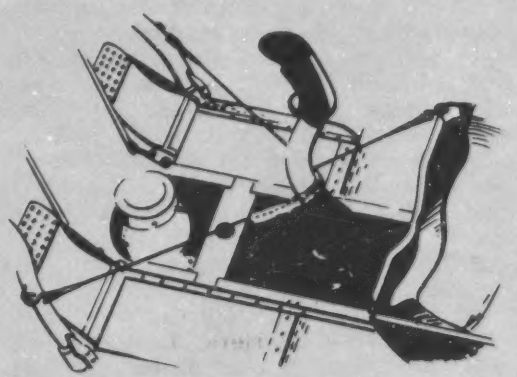

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Figure 3-2. — Parking harness.

## HANDLING AIRCRAFT ON CARRIERS

Aircraft carriers have a dual purpose today—both attack and antisubmarine warfare support capabilities. Other types of carriers, e.g., LPH and LHA, have been developed for specialized and supporting roles. Each type carries certain aircraft and equipment designed to fulfill the specific carrier's m'ssion. Those departments which contribute directly to the primary mission of an aircraft carrier are the operations department, weapons department, carrier air wing, and air department.

The combined efforts of both officers and men are necessary to make air operations on a carrier effective. It is certain that without exceptional organization and teamwork on the part of all hands, the operations of an aircraft carrier would not be possible; therefore, the efficient and coordinated efforts of all personnel concerned are of vital importance to the success of all air operations. The success of these operations depends largely on factors such as organization, training, and experience of the senior flight and hangar deck personnel.

During flight operations the speed with which aircraft can be launched or recovered depends largely upon the efficiency of the directors handling the aircraft. The efficiency of the directors depends on the leadership and knowhow of the ABH1 or ABHC in charge of them.

The aircraft handling group, under the aircraft handling officer, is responsible for launching, recovering, handling, and servicing of all aircraft aboard the carrier. These various functions are the responsibility of more than one division. The two divisions in the aircraft handling group in which the ABH1 or ABHC may be assigned are the V-1 and the V-3 divisions which are responsible for the flight deck and hangar deck, respectively.

## FLIGHT DECK

A flight deck of an aircraft carrier is one of the most hazardous places in the world and one of the busiest spots in the Navy. There can be many differences in the flight deck arrangement of aircraft carriers. Equipment may be located differently, be of different size, or be of a different type. These differences are even greater between the various classes. The location, size, and type of equipment (elevators for example) can seriously affect the methods of flight deck operations.

The handling of all aircraft on the flight deck is the responsibility of the V-1 division. This includes directing and spotting aircraft, operation of elevators, and operation of aircraft handling equipment such as tractors and cranes.

Also included in the V-1 division is the crash and salvage crew. The major concern of this crew is the handling of crashed aircraft and the manning of firefighting equipment in the event of any emergency situation. The duties and responsibilities of the crash and salvage crew are discussed in chapter 4 of this Rate Training Manual.

There are basic organizations within a V-1 division; one covers the military or administrative aspects and the other the flight quarters or operational organization. All personnel in the V-1 division come under these organizations, and their duties may be alike or varied.

The operational organization for a V-1 division covers the flight quarters station assignments. These assignments are outlined in the ship's battle bill. In this organization the division officer becomes the flight deck officer, and the assistant division officer becomes the crash and salvage officer.

The crash salvage chief, safety petty officer, and damage control petty officer are designated for each organization. This basic organization will vary from ship to ship due to operational requirements, number of personnel in the division, and other factors.

### Flight Deck Chief

The flight deck chief (FDC) is the overall supervisor of the flight deck. The FDC is the assistant to the flight deck officer (FDO) and is charged with a tremendous responsibility. The FDC is responsible for the operations on the flight deck, the training of aircraft directors, proper operation and readiness of all flight deck aircraft handling equipment, and all safety precautions/procedures concerned in any movement of aircraft on the flight deck.

It is not feasible to list all the duties and/or responsibilities of the flight deck chief due to the flexibility of his billet; however, some of the major duties and responsibilities include the following:

1. Conduct prelaunch briefings of plane directors.
2. Supervise flight deck personnel in the spotting, respotting, and securing of all aircraft on the flight deck.

3. Supervise and direct the training of personnel assigned to the flight deck, and administer the division, subject to the direction of the division officer or higher authority.

4. Supervise the movement of aircraft between the flight deck and the hangar deck via the aircraft elevators.

5. Ensure that elevator operators and phone talkers are well qualified and have an understanding of and observe all applicable safety orders.

6. Ensure that the crash salvage crew mans the appropriate firefighting stations for either flight or respotting operations.

7. Ensure that all aircraft handling equipment is in good working order and that the required equipment is readily available.

8. Ensure that only qualified, licensed operators are allowed to operate tow tractors, cranes, etc.

9. Enforce the wearing of the prescribed flight deck uniform, paying particular attention to the wearing of goggles, sound attenuators, and other safety devices.

10. Direct the utilization of flight deck handling crews.

11. Conduct and maintain a continuous training program to ensure the expeditious and proper performance of the handling crews.

12 .Supervise the loading and off loading of aircraft.

13. Take all necessary action to ensure the prompt movement of aircraft to fulfill the requirements of the operational schedule.

14. Keep the division officer advised of all matters concerning safety, status of equipment, performance of personnel, etc.

15. Act as principal observer, inspector, and evaluator of his men's performance.

Flight Deck Leading Petty Officer

The flight deck leading petty officer functions as an assistant to the flight deck chief and has the following duties and responsibilities:

1. Be familiar with all aspects of movement of aircraft on the flight deck and ascertain the training requirements of the handling crews to ensure the expeditious movement of aircraft.

2. Supervise the directors and crews in the proper spotting, respotting, and securing of aircraft.

3. Become familiar with all other duties of the flight deck chief.

4. Assume the duties of the flight deck chief in his absence.

Experience has taught that the flight deck chief must be the senior supervisor, but at the same time be one who realizes that the whole job cannot be done alone. The flight deck chief and the flight deck PO, together, must supervise the flight deck until the very last man knows his job and knows it thoroughly.

Flight Operations

In most operations advance word will be given to allow time for planning. However, special missions often arise which necessitate maximum effort on the part of the flight deck crews to get the launch off on time. For this reason the importance of flexibility and broad training of the flight deck crews cannot be overemphasized.

To a person watching flight deck operations for the first time the activity alone presents a confusing picture. Some have called carrier flight deck operations the greatest show on earth. They cannot determine how and why the aircraft are launched and moved around as they are with maximum efficiency. The success of these operations depends largely on factors such as organization, training, experience and sound operating procedures.

There can be no uncertainty on a carrier flight deck at any time during flight operations. Each man must know where he belongs and the job that he is to perform. Orders must be given so that they are clearly understood and carried out.

NOTE: General flight deck and hangar deck procedures are contained in the CVA/CVS NATOPS (Naval Air Training and Operating Standardization). As the title implies, this manual standardizes the procedures for shipboard aircraft handling, and compliance with these procedures is mandatory.

While flight decks are hazardous areas, the danger can be minimized by reducing the chance of a hazard changing into a dangerous situation. This can be accomplished by constantly evaluating ever-changing situations, looking out for the other man first, and developing team effort.

In order to take steps necessary to avoid hazards, the individual must first recognize that these dangers are, in fact, real and could turn into an unpleasant statistic. Once the hazards are recognized they can be dealt with realistically. Applying command policy, standard

operating procedures, training principles, and a continuous safety program are the solution.

An indoctrination program for men being introduced to flight deck operations for the first time must be vigorously carried out, and should include air wing personnel. Unauthorized personnel must not be allowed on the flight deck at any time during flight operations.

Every man in the division should know that he is doing one of the most important jobs on the ship—and be mighty proud of it. The grueling work associated with flight deck operations must never be allowed to assume connotations of punishment. An effective and safe flight deck is invariably a disciplined deck.

As flight deck chief or leading PO, you can ensure that there is one thing for which there is no room on the flight deck—carelessness.

OPERATIONS FLIGHT SCHEDULE.—The operations department prepares the flight schedule for each day's operation. For special operations this schedule may cover more than 1 day's operation but normally it is for only 1 day. This schedule is intended to cover the ship's air wings and squadron's training or operational requirements and commitments. A copy of this mimeographed schedule is distributed to all departments/divisions concerned.

This schedule gives the launch and recovery times; the number, type, and squadron of the aircraft in each launch; the fuel loads and ammunition types and quantities; and any other information such as launch sequences, launch priority, and which spare aircraft are required. Ammunition types and loads are usually given in the note section where there is insufficient space on the schedule.

There are many things that can change the schedule during the day's operation or even before the day's operation commences. The schedule must be compiled in advance of the operation (usually 10 to 12 hours); therefore, aircraft status can change, target areas may not be available, or weather may change in the ship's operating area or the target area.

The number of aircraft to be launched must be based on the squadron maintenance department's prediction of what aircraft will be in an UP status for the coming day's operation. Additional aircraft may be assigned when and if they become available. At times when the expected aircraft do not reach an UP status the whole launch may be canceled or changed. Some missions require an exact number of aircraft. One aircraft in a DOWN status can be the cause for changing the entire mission.

The personnel in charge of the flight deck must be ready to expect a change in the launch sequence or to hold or add certain aircraft at a moment's notice. At times, test hops may be added to the schedule at the request of the squadron's maintenance department. All changes to the schedule must be approved by the ship's operation department.

PLANNING THE SPOT FOR FLIGHT OPERATIONS.—Most carriers have a basic spotting order. The aircraft are spotted for launch in approximately the same location each time. This spotting order varies from carrier to carrier to suit the flight deck layout. Certain aircraft must be spotted in a specific location to permit servicing, loading of ammunition, starting, maintenance, etc. In the case of certain large aircraft, the location should be such that the aircraft does not interfere with the movement of other aircraft or is such that they do not need to be moved during launching or recovery operations.

The aircraft handling officer and/or flight deck officer, using the flight schedule, the aircraft status board, and advice from the squadron maintenance chiefs as to what aircraft may be ready, assigns the aircraft by side number to the scheduled launch. The squadron may request specific aircraft but the final decision rests with the aircraft handling officer.

After the decision has been made as to which aircraft are to be used, the aircraft handling officer, flight deck officer, flight deck chief and/or flight deck PO, using templates and the ouija (wee-gee) board, decide on the best location for the GO aircraft.

Jet aircraft are usually spotted in a turnup position with the engine exhaust over the side of the deck unless they are spotted on the catapult or in a ready position behind the catapult. Jet aircraft should always be pointed as nearly as possible into the wind for starting. This is done to help prevent starting fires and hot starts.

Reciprocating engine aircraft are normally spotted on the aft end of the flight deck with the GO aircraft in the front rows. Jet aircraft are normally spotted along the deck edge with the first-to-be-launched aircraft aft; however, the first-to-be-launched aircraft may also be fed in from the forward spots, depending on the type of flight deck.

When there are a very large number of aircraft to be launched, some of the GO aircraft may be spotted on the hangar deck, brought up on an elevator during the launch, and started.

When the spot and the operation of the launch are planned, the aircraft handling officer makes a spotting sheet or card to indicate the location of the aircraft. A copy of this sheet or card is given to each director on the flight deck. This card may also contain notes as to specific launching sequences.

PRELAUNCH BRIEFING.—Before each launching operation, a briefing is held by the aircraft handling officer. This briefing is attended by the catapult officer, the flight deck officer, the hangar deck officer, the PO in charge of tow tractors and starting equipment, the flight deck chief, the leading PO, and all flight deck directors and spotters. During this briefing, specific launch procedures and sequences are given. The disposition of aircraft that go "down" during the launch is determined, and each director and spotter is informed as to his specific part in the operation. After the briefing, each director informs his crew as to the details of the launch. After the first launch of the day, details of the recovery are also included in this briefing; for as soon as the last aircraft has left the deck the previous launch must be recovered. The crews must also be aware that the need for a "ready" deck may arise at any time due to an emergency situation.

NOSE GEAR LAUNCH (CATAPULT SPOTTING).—The takeoff requirements of jet aircraft necessitate the use of the catapult for launching purposes. With the use of modern catapults, the time interval between each launch depends more on the flight deck directors and catapult spotters than on the catapult(s). The most experienced directors should always be assigned as catapult spotters. There is no room for the smallest error by the spotter if a good launch interval is to be maintained. The position of the aircraft on the catapult is critical. The distance that the aircraft can be off center in relation to the catapult will vary with each type of aircraft, but the maximum for any aircraft is about 6 inches. The nosewheel on some aircraft must be perfectly lined up, and the aircraft must not be cocked more than a specified amount in relation to the catapult.

Some types of aircraft are equipped with catapult nose gear launch equipment. This equipment provides a safer and more efficient means of aircraft alignment and hookup than the bridle/pendant launch system.

When spotting an aircraft in preparation for launch, having this type of launch equipment, direct the aircraft to the mouth of the approach ramp and signal the pilot to lower the launch bar from taxi position to the deck. The aircraft is then steered into the aft end of the approach ramp and continues forward (not to exceed 4 knots) until the trail bar engages the buffer slider. When the aircraft stops and the launch bar drops into position, the catapult deck edge operator is signaled to give bridle tension.

In the event it is necessary to respot an aircraft equipped with nose launch gear (after a catapult hookup) signal the pilot to reduce aircraft power. After all applicable procedures are followed to release the aircraft from the catapult, direct the aircraft forward (under its own power) until the launch bar clears the forward end of the deck ramp (the launch bar will automatically spring up into taxi position). Remove the aircraft from the catapult as directed.

When launching with conventional launching systems, the speed of the aircraft must be controlled by the spotter so that the catapult holdback man is able to connect the holdback. The holdback must not be used to stop the aircraft as any undue strain on the tension bar or ring requires that it be changed. If the aircraft overruns the holdback and the holdback man is unable to connect the holdback, the aircraft must be pushed back manually by a handling crew. Any time that an aircraft must be repositioned, the time for the entire launch interval is greatly increased.

When an aircraft on the catapult goes "down," the spotter and directors must know where to spot it to prevent interference with the rest of the launch. The procedure for removing a DOWN aircraft from the catapult will vary with the flight deck layout, the number of aircraft still to be launched, and the space available on the hangar deck and/or flight deck.

DECK LAUNCHING.—The deck launching method can only be used when the required amount of clear deck can be obtained for takeoff run. When the amount of deck run is determined, it is verified by the air officer, using the tables for each type aircraft. Directors feed aircraft out of the pack to a predetermined spot on the flight deck where the flight deck

officer takes over and gives the signal for launching.

The angle portion of the flight deck is sometimes used on carriers to deck launch certain aircraft. This can only be done when the majority of the aircraft are spotted forward on the flight deck and the required takeoff distance can be obtained.

RECOVERY.—When the last aircraft has been launched, the remaining aircraft in the landing area of the deck must be moved. A line painted on the flight deck, known as the safe parking line or "foul line," separates this area from the rest of the deck. No portion of any equipment or aircraft should be in this area. All personnel must remain back of this line during landing operation except those specifically authorized to enter the landing area.

When the aircraft has been released from the arresting gear wire, the fly three director directs the aircraft clear of the landing area. The speed with which the aircraft clears this area has a bearing on the landing interval.

A basic spot is used for recovered aircraft much in the same way as in the launching spot. Experience with spotting the different aircraft assigned to the ship determines this spot. As an exact landing sequence cannot be determined in advance, the directors must take the aircraft as they come aboard and spot them in the most feasible locations. These locations should be as close to the basic spot as possible. On large recoveries some of the aircraft must be sent to the hangar deck to give sufficient space for the entire recovery. This is especially true when it is necessary to hold an aircraft on the catapult in a ready-to-launch-condition.

When it is possible to determine, in advance, which aircraft are going to be in a down condition upon landing, it may be possible to send these to the hangar deck on recovery. (EXAMPLE: An aircraft going into check.)

An alternate spot should be determined before the recovery for aircraft with blown tires. Some aircraft cannot be taxied any great distance with a blown tire. Some require towing with a tractor because they are impossible to control when taxiing with a blown tire.

A tow tractor should always be kept in a ready condition during recovery operations to tow aircraft from the landing area that have blown tires or some other condition that prevents them from being taxied.

The flight deck handling crews must also be trained and ready to assist in rigging the barricade. The arresting gear crews are responsible for making the hookup but must have assistance from the flight deck crews in stretching the webbing across the flight deck.

RESPOTTING.—Respotting aircraft on the flight deck becomes an exercise in cooperation between personnel that make up the refueling and rearming crews, squadron personnel, and the plane handlers. Servicing, maintenance, and rearming of the aircraft start as soon as the first aircraft recovered is spotted, and continue through the recovery and respotting periods. The plane director has basic control over these operations due to the required moving of the aircraft. The director must decide if the servicing or other operation on the aircraft is to continue or be halted. Servicing and maintenance must not be allowed to interfere with the orderly flow of aircraft during the respot. On the other hand, servicing and maintenance should not be stopped unnecessarily.

During the respot, DOWN aircraft that would interfere with operations are sent to the hangar deck, and aircraft in an UP status needed for the next launch are brought to the flight deck. Respotting aircraft on the hangar deck for maintenance purposes may be done at this time. It may be necessary to bring some of these aircraft to the flight deck temporarily in order to have room to respot the hangar deck.

When there is space available, aircraft that are not needed for the next launch are sent below. Aircraft are usually respotted in the basic spotting order. At times this order may be modified slightly when a special launch is to be carried out, but normally each squadron will have an area for its aircraft.

During the respot, the directors must be especially watchful to prevent crunches. There is always the likelihood of a crunch when moving aircraft under the adverse conditions of flight operations aboard a carrier. A thorough and vigorous anticrunch program must be carried out, and the flight deck chief and flight deck PO are the ones to ensure that it is carried out.

The launching, landing, and respotting can be halted at times because of elevator casualties. The term casualties is used here to indicate an inoperative elevator. The elevator platform can be in any position—all the way up and locked, down, or any position in between. On some carriers where the elevator platform is part of the landing area, the platform not locked

in an UP position can prevent the landing of any aircraft. The launching of aircraft may also be halted when the forward center-of-the-deck elevator cannot be locked in an up position.

The elevator casualty of major concern to the ABH is a casualty to the forward center-of-the-deck elevator. When the locks cannot be installed on an elevator, aircraft should not be taxied across it. When the elevator is down during a recovery it poses a problem in spotting the aircraft as they are recovered. Aircraft must be taxied around it, the area left for spotting is severely limited, and those aircraft that were required to be sent to the hangar deck to make room for the recovery must be sent down another elevator. Additional aircraft have to be sent to the hangar deck to make up for the lost space. The deck edge elevators have to be utilized for this and may seriously affect the landing interval. When the casualty occurs before the recovery, plans can be made to provide for it. When the casualty occurs during the recovery, the flight deck chief and leading PO must use all their experience and ingenuity in directing the spotting of the aircraft to ensure that all can get aboard.

COMMUNICATIONS.—Rapid, accurate exchange of information is a necessity for a smooth, safe, and efficient flight deck operation. Enough of the plane directors must have radio-equipped headsets, and the phone talkers must have phones with leads long enough to obtain a maximum coverage of the flight deck. Good communications then becomes a matter of discipline. Every time an aircraft moves an inch or anything else significant occurs on the flight deck, information should flow smoothly to and from flight deck control. The aircraft handling officer must have this information if he is to maintain control of the operation. The flight deck chief and leading PO must ensure discipline on these circuits by maintaining a training program for phone talkers and directors and by exercising a continuous check on their use. (Refer to NAVEDTRA 10054 (Series).)

General Safety Precautions

The enforcement of flight deck safety precautions is one of the major duties of the flight deck chief and the leading PO. He must ensure that ALL personnel working on the flight deck observe and practice the safety precautions required by the air department instructions and higher authority. This includes personnel of other divisions, departments, and squadrons, as any laxity on their part affects the safety of men, equipment, and the ship.

Nonstandard director signals can cause pilot confusion and create accident hazards; therefore, the first and foremost safety requirement is the use of standard signals. Directors tend to develop their own personal, colorful, and dangerous interpretations of standard taxi signals if they are allowed to do so. It is the responsibility of the ABH1 and ABHC to ensure that only the standard signals are used. If any discrepancies are reported, immediate steps must be taken to correct them.

The accident potential takes a tremendous increase during periods of darkness, and requires extra precaution on the part of both pilots and crew. Launches in darkness normally involve the lack of depth perception, which results in error of distance judgment. To compensate for this deficiency, small launches with additional spacing between parked and taxiing aircraft should be standard. The directors must make slower movements with the lighted signal wands to ensure that the pilot understands clearly the intent of the given signal. A problem which sometimes gets out of hand when not constantly stressed is the director's moving on the deck while giving taxi signals at night. This gives the pilot the illusion he is not moving his aircraft since there is no relative motion between the director and the aircraft. The pilot tends to add more power to respond to the director's signals. When the director stops, the pilot then realizes that he is moving too fast. Thus, the accident potential is increased.

An indoctrination program is utilized for those personnel new to flight deck operations or who have not worked on the flight deck for an extended period of time. New personnel should not be used for night operations until they are thoroughly familiar with day operations.

Strict enforcement of wearing proper flight deck uniforms must be carried out. The correct wearing of helmets, goggles, and sound attenuators is a major problem. Directors and other equivalent personnel should be held responsible for the men in their crews. Personnel working on the flight deck should be prevented from carrying loose gear (books, rags, etc.) in their pockets. There is always the danger of loose gear being drawn into a jet engine intake.

When moving aircraft aboard an aircraft carrier, ensure there is proper clearance, and watch for unexpected ship movement that may have a bearing on aircraft being moved. Be extremely cautious when moving on and off elevators. There is always danger of losing one over the side.

Inattention or improper handling or spotting of the aircraft causes the loss of an aircraft or some unscheduled maintenance.

The problems involved during operations are a product of flight deck crews, pilots, weather, a pitching deck, and last but far from least, tempo of operations. These are elements of the carrier environment and for the most part cannot be altered; however, the number of crunches and hazards can be decreased through alertness, cooperation, and training, and doing the job in a professional manner.

The hazards of a carrier flight deck cannot be overemphasized because of the danger to personnel and property. Safety is an area in which responsibilities increase with advancement. As an ABH1 or ABHC, you must know and observe all safety precautions for the equipment you use and the work you do. In addition, it is your responsibility to ensure that all men working under your supervision also observe the proper safety rules and procedures. Safety is a never-ending job that must be emphasized so strongly that doing all jobs in a safe manner becomes the accepted and routine procedure at all times.

Safety precautions and directives issued by the commanding officer and higher authority should be followed to the letter in their specific application. It is the responsibility of the flight deck chief or flight deck PO to correctly interpret their application to his men. The major objective of safety precautions is prevention—it is much better to prevent an accident than to give first aid to someone injured. Should any occasion arise in which any doubt exists as to the application of a particular directive or precaution, the measures to be taken are those which will achieve maximum safety.

Flight Deck Crew Safety
Clothing and Equipment

For apparent reasons, flight deck life preservers and protective helmets (sound attenuating) should be worn whenever a person works on the flight deck, flight operations, respot, etc. Strict enforcement of wearing proper flight deck uniforms must be carried out. The correct wearing of helmets, goggles, and life preservers is a major problem. Directors and other supervisory personnel should be and are held responsible for the men in their crews, as well as any other person(s) not in proper flight deck attire.

The Mk 1 Life Preserver, designed for use by flight deck personnel, is available in three sizes: small, medium, and large, and in seven colors to designate the various aviation functions. These preservers are comfortable, durable, and washable and should be used to the best advantage.

Information relative to the use and periodic testing of this life preserver (NSN 2H-4220-00-926-9438 through 9458) can be found in NAVSHIPS Technical Manual, chapter 9331. Some of the general inspection and testing procedures pertaining to this preserver are as follows:

1. Examine all mechanical gear on the preserver to ensure that it is in working order.
2. Check to see that the tip of the piercing pins (of the inflater assembly) has not been bent or otherwise damaged.
3. Inflate the preserver orally and examine for leaks. Preservers with leaks or other defects should be repaired or replaced. Holes in the buoyancy chamber can be repaired with the authorized repair kit (NSN 9C-4220-00-399-6213).

When the life preserver is being worn, it is imperative that it be closed in front with the snaps provided, so that it will not come off in the water. To provide some initial buoyancy, one or two breaths may be blown into the buoyancy chamber orally (but only when the increased bulk of the preserver, due to the partial inflation, does not become a work hazard).

Lifevests must be kept away from oil, paint, and greasy substances as much as possible since these materials can accelerate deterioration of the fabrics in the preserver. Sharp edges of various items about the flight deck are "wear and tear" hazards to be avoided.

Protective headgear and goggles are also a must item to be included in proper flight deck uniforms. In short, they are good insurance in reducing personnel injuries.

HANGAR DECK

The operations of an aircraft carrier would be almost impossible without a smoothly and

efficiently operating hangar deck crew. The movement of aircraft on the hangar deck creates special problems due to the limitations of space. Therefore, a great deal of advanced planning must go into the spotting of aircraft to prevent the blocking of UP aircraft with DOWN aircraft and those that cannot be moved. The close quarters and irregular shape of the hangar deck areas require the constant attention of the directors and handlers to prevent crunches. The handling equipment for the hangar deck is mostly manpower; however, the spotting dolly can, while providing maximum maneuverability, spot aircraft equally effectively in congested areas as in the open. There is not room in most cases for tow tractors.

The V-3 division organization is much the same as that of the flight deck. It is also based on two organizations — administration and operation. The main difference is in the number of men assigned. There are fewer handling crews, but the number of men in each crew should be greater because most of the movement of aircraft is done by manpower.

The hangar deck division is charged with the handling of all aircraft on the hangar deck. Other responsibilities include operation of aircraft elevators, hangar bay doors, ballistic doors, roller curtains, and assigned firefighting equipment such as sprinkler systems, water curtains, and foam monitors. Certain personnel from V-3 division man the conflagration control stations on the hangar deck.

Duties of the hangar deck chief and the leading PO are basically the same as those of their counterparts on the flight deck.

Flight Operations

The hangar deck officer, with the assistance of the hangar deck chief, is responsible for the movement of all aircraft from, onto, and on the hangar deck. The movement of any aircraft must be coordinated through the aircraft handling officer.

There are two types of spotting that concern the hangar deck handling crews: operational and maintenance spotting.

OPERATIONAL SPOTS. — Aircraft that are not needed for a launch may be sent to the hangar deck to increase the amount of room for operations on the flight deck. These aircraft will normally be needed for the next launch on the flight deck and must be readily available to be sent back to the flight deck. Care must be taken in choosing their spots so that this movement is not blocked.

Information as to the UP or DOWN status of the aircraft must be given to the hangar deck officer or chief at the time or before the aircraft is sent to the hangar deck. The flight deck personnel must cooperate in the operation by sending the aircraft in a sequence most advantageous to the hangar deck. At times it may be necessary to send some aircraft from the hangar deck to the flight deck and then return them to the hangar deck with the additional aircraft. This is to prevent "burying" UP aircraft behind DOWN aircraft. Servicing of some aircraft is also required on the hangar deck. Spotters of the aircraft must take this into consideration. Care must be taken to prevent crunches while moving the aircraft. Extreme caution must be used when moving aircraft on the hangar deck since the aircraft are spotted closer and parked tighter than on the flight deck. There is an added danger as a result of the many and varied pieces of maintenance equipment that are employed and positioned around the hangar deck. They are always a potential "crunch hazard."

Care must also be taken in spotting so that overlapping wing and tail surfaces are not forced together due to an increase in weight of the aircraft when fuel is put into the tanks of the aircraft with its wing on top. The reverse can happen when defueling an aircraft and its wing is on the bottom.

At times the aircraft may be sent to the hangar deck just for refueling or defueling. Care should be taken in spotting so the tank openings are not blocked, making the operation impossible.

MAINTENANCE SPOTTING. — The spotting of aircraft for maintenance on the hangar deck is the largest problem of the hangar deck crews. The condition of the aircraft undergoing a "check", extensive maintenance, or repair may prevent its being moved. When the aircraft must be placed on jacks, only a certain area of the hangar deck can be used because of the lowness of the overhead in most areas. Aircraft undergoing an engine change or check require additional space to perform the work. For some jet engined aircraft this requires considerable space. Aircraft maintenance that will keep the aircraft from being moved should not be undertaken without the approval of the hangar deck officer or chief and the aircraft handling officer,

no matter how much or little time is required for the work to be performed.

Cooperation between the hangar deck chief, flight deck chief, aviation fuels chief, and the squadron maintenance chief is a must if the hangar deck is to operate smoothly and efficiently. The hangar deck chief is responsible for the movement of all aircraft on the hangar deck. It is necessary that he be informed of any operation requiring the movement or preventing the movement of any aircraft on the hangar deck.

Safety Precautions

Safety precautions for the hangar deck are much the same as for the flight deck. Aircraft must be moved into and out of tighter areas on the hangar deck than on the flight deck, and movement of the aircraft in many cases is by manpower alone. All the fire hazards present on the flight deck are present on the hangar deck plus the disadvantage of restricted movement.

One of the major responsibilities of the hangar deck chief and leading PO is enforcement of the ship's regulations and safety precautions on the hangar deck.

Some of the safety precautions for the hangar deck are as follows:

1. All equipment, machinery, and gear that are not being moved or used must be securely tied down.

2. All tiedowns that may be in an area used as a passageway should be marked with a rag or other device to increase their visibility. The sharp trailing edges of wings and horizontal tail surfaces that may be positioned in such a way that they are not readily visible should be padded or marked.

3. When moving an aircraft, make sure a qualified plane captain is in the cockpit and that he is fully aware that the aircraft is to be moved.

4. There should be a safety man stationed at any point of the aircraft that cannot be seen by the director. When there is any doubt as to clearance, stop the aircraft and make sure of adequate clearance before proceeding. Be especially watchful of the clearance between the vertical fin of the aircraft and the overhead.

5. Make sure there is a sufficient number of men to handle the aircraft when moving it.

6. When an aircraft is to be turned up on the hangar deck, make sure that permission has been obtained from the aircraft handling officer in flight deck control and that all ship's regulations are observed. Safety men from the squadron, with sufficient line to block off the area, must be stationed around the aircraft.

Each ship has safety precautions that are unique to that ship due to special circumstances and operational requirements. Each petty officer of the division must know and enforce those that apply to him and his men. New men coming into the division should be required to read and sign a listing of these precautions.

LHA/LPH/LPD HELICOPTER HANDLING

Other carriers of a specialized nature are the LHA (General-purpose Amphibious Assault), the LPH (Amphibious Assault), and the LPD (Amphibious Transport Dock). These ships are to support the vertical envelopment phase of amphibious operations. The LHA/LPH and the LPD transport and land troops, equipment, and supplies, utilizing transport helicopters, landing craft, and amphibian vehicles.

The first LHA, the Tarawa, was built from the keel up and was launched in December, 1973. It is 820 feet long, 106 feet wide, and features a full-length flight deck that can handle nine helicopters simultaneously. The ship also has a large hangar deck.

Helicopters are moved from the hangar deck by either the aft centerline elevator or the deck-edge elevator. Both elevators can handle helicopters with a gross weight of about 38,000 pounds. The aft elevator was designed to handle large helicopters, like the large CH-54 flying crane, which can be stowed on the flight deck fully assembled, or in the hangar deck with the blades folded.

The first LPH, the Thetis Bay, was converted from an escort carrier. Some Essex class carriers have been converted to amphibious assault ships. Some other LPHs have been built from the keel up for this specialized mission. The first one built from the keel up was the Iwo Jima (LPH2).

The first LPD, the Raleigh, was built from the keel. The LPD has a wet well for launching large landing craft as well as a flight deck for launching and landing helicopters. There are no facilities on this type ship for striking helicopters below deck. An LPD usually teams up with an LPH (when air transportation is required for troops, equipment, etc.), and utilizes the helicopters from the LPH.



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The ABH assigned duty on an LHA/LPH is assigned to either the V-1 or the V-3 division. The air department for this type ship is basically the same as the CVA/CVS class carrier. The air department on the LPD has only one V division, and usually all aviation ratings are assigned to this division. The ABH's duties include directing helicopters during launching and landing operations and other duties as may be assigned.

General flight deck and hangar deck procedures are contained in applicable LPH and carrier NATOPS Manuals. These may be referred to for specific type aircraft. Some general procedures are as follows:

1. Personnel not required for plane handling must remain clear of the flight deck during launching and recovery operations.
2. Starting the auxiliary powerplant, engines, rotor turnup, and taxiing will be done upon the direction of personnel from the ship's air department.
3. There must be maximum safe relative wind conditions for unfolding or folding rotor blades.
4. Extreme caution must be exercised during preflight inspections and flight operations.
5. All flight deck operations are executed on signals from Primary Flight Control.
6. Taxiing and movement of helicopters will be under the positive control of the directors.

Under normal conditions, while directing the taxiing of helicopters, the director will at all times assume and maintain a position from which the eyes of the pilot are visible. Normally this position will be forward and to the right of the nose of the helicopter, immediately outboard of the rotor blade tip path. Under specific conditions (such as may occur aboard a carrier), the director will assume a position best suited to the specific environment.

Handling a helicopter aboard ship requires strict adherence to safety measures and trained handling crews, utilizing standard procedures and signals. A great deal of special handling of helicopters is required for safe and efficient operation; precautions must be practiced and observed in all movement to preclude the possibility of injury and/or damage.

Night operations are always the most critical for both pilots and the flight deck crews. The tempo of operations must be reduced in both volume and speed when compared to day operations. Slow and careful handling of helicopters by the flight deck crews is mandatory; therefore, particular attention must be given to ensure that all personnel involved in flight deck operations are well briefed in their duties and procedures.

Movement of helicopters will be accomplished, when feasible, by using a tow tractor equipped with an appropriate tow bar. As an example for towing procedure, the CH46A-type helicopter is given. The aircraft may be towed by the nosewheel using a Navy Universal Tow bar. Full 360 degrees swivelling of the nose gear shimmy damper enables the helicopter to be towed with the scissors assembly connected. When directing the towing of the helicopter, the director will assume and maintain a position in front and to the right of the helicopter (outboard of rotor tip path), keeping the eyes of the pilot/crewmember and the driver of the tow vehicle visible at all times. Tow the helicopter using the procedures as follows:

1. Ensure that external power and obstacles are removed, and the cockpit is manned by qualified personnel to apply brakes when necessary.

2. Close all access panels and doors to prevent damage to the helicopter.

3. Remove loose objects that could fall from the helicopter during towing.

4. In congested areas, one crewmember should be placed at the left-hand side of the helicopter just outboard of the rotor blade tip path in sight of the director. All signals from the crewmember will be directed to the plane director.

5. Connect the tow bar to the helicopter and the tow vehicle. Remove all tiedowns and wheel chocks.

6. Release the parking brakes, unlock the nosewheel and, if towing at night, turn the navigation lights ON.

7. Do not start or stop too suddenly. Tow the helicopter straight ahead before turning. Do not exceed the maximum speed of 5 mph during towing.

8. Tow the helicopter smoothly and do not use the helicopter brakes for steering.

9. Use brakes only when necessary, as this may cause wheels to overheat. If the helicopter brakes must be used for emergency stopping,

Table 3-1.—Helicopter launch and land commands

| Evolution | Command from fly control | Display at fly control | Meaning/action |
|---|---|---|---|
| Preparation to start engines. | "Check tiedowns, chocks, and all loose gear about." | Red flag and red light. | Verify tiedowns on, chocks in place. Bootman untie boot lines and handhold lines. Secure all loose gear. Man fire extinguishers. |
| Start engines. | "Start engines." | Red flag and red light. | Authority for responsible flight deck personnel to signal for starting of, engines. Ship not ready for flight operations. |
| Engage/disengage rotors. | "Stand clear of helicopter (s)"—(20-second pause). "Engage/disengage rotors." | Red flag and red light. | Deck is clear of all personnel not required. Authority for responsible flight deck personnel to signal for engaging rotors when their immediate area is clear. Ship not ready for flight operations. |
| Launch. | "Launch helicopter (s)." | Green flag and green light. | Ship is ready in all respects for flight operations. Authority for responsible flight deck personnel to launch helicopter when pilot is ready and tiedowns removed. |
| Helicopter (s) approaching for landing aboard. | "Prepare to land helicopter (s)." | Red flag and red light. | Prepare designated landing area to land helicopter (s). Ship is not ready. |
| Recovery. | "Land helicopter (s)." | Green flag and green light. | Ship is ready in all respects to land helicopter (s). |

apply the brakes evenly to avoid swerving and subsequent damage to the helicopter.

10. When towing is completed, place chocks fore and aft of each landing gear, set the parking brake, and disconnect the tow bar from the tow vehicle and helicopter.

When the tractor is not practical, pushing crews may be used. These crews must be instructed as to those areas of the aircraft that are capable of taking external forces. In all cases of deck movement, a crewmember must be in the cockpit to ensure that the helicopter is moved at a slow and safe speed.

For detailed towing procedures for different type helicopters, consult the applicable Maintenance Instructions Manual (General Information section).

## FLIGHT DECK PROCEDURES

All flight deck operations, including starting of the auxiliary powerplant, engines, engaging rotors, removing tiedowns, etc., are executed on signals from PriFly via the director.

The preparation for starting the auxiliary powerplant and engines should be accomplished by the helicopter crew immediately after they enter the helicopter, and when PriFly issues instructions to start engines, the director gives the start engine signal to the pilot; the pilot then starts the engine. A visual signal will be passed to PriFly via the director as soon as the pilot determines that he is ready to engage rotors. The rotors will be engaged only upon the signal from PriFly to the pilot via the director. The following requirements are mandatory for engagement of the rotors:

1. Rotor blade tiedowns removed.
2. Deck tiedowns secure and chocks in place.
3. Flight deck area clear of all unnecessary personnel and loose gear.
4. Nosewheel locked and parking brake on.
5. Required relative wind velocity.

After the rotor engagement is completed and the pilot is ready for takeoff, he will indicate an "up status" signal to the helicopter director. Following an UP status signal, and when directed by PriFly, the tiedowns will be removed. As soon as practical after the tiedowns are removed, the director signals the pilot for takeoff.

When PriFly issues instructions to prepare to land a helicopter, the director and handling crew take up their stations in the designated area, and when the ship is steady on course and ready to receive the helicopter, PriFly issues instructions to land the helicopter. Normally the approach of the helicopter will be from the 180-degree position, and will be near a hover attitude with a minimum rate of closure as it crosses the deck edge of the ship and comes to a hover over the designated landing area. Touchdown on the designated landing spot will be made when the director gives the appropriate signal. See table 3-1 for the sequence of signals between director and PriFly and vice versa.

The signals for a normal sequence of action during launching and recovery operations are given in ABH 3 & 2, NAVEDTRA 10300 (Series). At times there may be changes to these signals; therefore, always refer to the latest edition of NWIP 41-6 for approved helicopter signals.

Launching and recovery procedures are basically the same for LPD ships; however, due to the configuration of these ships (limited deck space, gun mounts, cranes, etc.), the director may launch the helicopter to either port or starboard.

In general, flight deck operations may cause some confusion between pilots/crew and the helicopter directors. All signals must be clearly understood by everyone concerned so as not to leave any doubt about procedures. When in doubt, stop and find out; this is especially important in the movement of helicopters.

# CHAPTER 4

# AIRCRAFT CRASHES, FIREFIGHTING, AND CREW ENTRAPMENT

This chapter discusses the duties, responsibilities, and organizational structure of Aircraft Fire/Rescue crews (both ashore and aboard aircraft carriers). Information concerning emergency fire/rescue equipment, aircraft crashes, aircrew entrapment, and rescue procedures is included.

## NAVAL AIR STATIONS

One of the primary command responsibilities of each naval shore activity is to maintain a reliable and effective firefighting organization of personnel and equipment.

On naval air activities, consideration is given to the two primary types of fires encountered—the aircraft fire and the structural fire. Each type requires different firefighting materials and procedures to effect rapid extinguishment.

The fighting of fires in and around grounded or crashed aircraft is a highly specialized branch of firefighting, which demands skill, courage, teamwork, physical agility, and mental alertness, and thus extends a challenge to firefighting and rescue personnel.

Fire may occur at any time during the operation or servicing of aircraft, but fires are especially critical following a crash, either on takeoff or landing. This type of fire spreads rapidly, and because of the unusual fuel dispersion and flame intensity, presents a severe hazard to the lives of those inside the aircraft.

An aircraft crash fire can occur on a variety of terrains and can involve high-test gasoline or jet fuels, rocket fuels, nuclear weapons, lubricating oil, and a fuselage damaged to varying extents. Combustion is sudden, backflashes are common, and explosions are a constant hazard to personnel and equipment.

Structural fires, on the other hand, are confined within buildings, usually are progressive in nature, and usually create a greater smoke hazard. These differences necessitate different methods of approach, removal of hazards, and extinguishing agents and procedures than for crash firefighting. As a result, extinguishment becomes a job for individual, specialized units. This specialization is necessary because the two types of firefighting differ greatly in many ways.

Special equipment is required for aircraft crash rescue because of these differences in types of fire and techniques of extinguishment. The crash crew employs trucks, helicopters, extinguishing agents, and tools not ordinarily utilized by a structural fire crew. The quantity of extinguishing agents is limited for the crash crew. Normally, an unlimited water supply from hydrants and other sources is available to the structural fire crew, but for the aircraft crash crew the required fire extinguishing agents usually are limited to the capacities of the crash crew trucks and airlift equipment.

Each crash crewman assigned to the firefighting department is to be trained in both crash firefighting and structural firefighting. The primary duty of any firefighter is saving LIFE; the secondary duty is to extinguish and limit damage by fire. To help the firefighter meet these responsibilities, the Navy has placed at his disposal the finest equipment available with the latest developments in this specialized science. Through continuous study and practice, the firefighter should master this specific art of firefighting so that he can operate with a maximum of speed and at the optimum of efficiency.

## CRASH-RESCUE SERVICE ORGANIZATION

It is a primary responsibility of each Naval Air Facility to maintain adequate, reliable, and effective organizations of personnel and

equipment to furnish emergency protective services in accordance with standard procedures. The basic standards are implemented by appropriate instructions as required to meet local situations and missions. It is the responsibility of each commanding officer to publish a detailed aircraft firefighting and rescue procedure, which follows the basic policies outlined by the Naval Air Systems Command. This detailed procedure must be posted at each location where aircraft emergency calls are received.

All personnel concerned with aircraft firefighting and rescue operations are listed in the Station Aircraft Firefighting and Rescue Procedure. This procedure outlines the responsibilities, requirements, and general procedures to meet local situations and missions.

Station Fire Chief

Each air station within the continental United States employs a civilian fire chief who is responsible for the operational readiness and performance of the crash-rescue organization. The fire chief, or designated crash captain, has control and command of the firefighting and rescue operation at the immediate scene of the accident. The air operations officer assumes overall coordination control of movement of aircraft, crash-rescue equipment, and other personnel and equipment involved on the field other than the immediate scene of the accident.

Training and Drills

Aircraft crash accidents and emergencies usually occur suddenly and with a minimum of advance warning. They permit no extensive on-the-scene preparation. Time and exacting operations with minimum waste motion or extinguishing materials are of extreme importance. Standard, comprehensive, and constant training must be afforded all crash firefighting and rescue personnel through a continuous on-the-job training program. Care must be exercised in the duty assignment of recruits and otherwise inexperienced and untrained personnel lest their actions unnecessarily impede action or possibly jeopardize the lives of crashed aircraft occupants or fellow personnel.

RESPONSIBILITY FOR TRAINING. — The crash fire chief is responsible for the continuous training of all aircraft firefighting and rescue personnel and crews, and other supporting personnel in accordance with NAVAIR Instructions and the mission of the activity.

All personnel engaged in duties incidental to aircraft operation (maintenance and servicing) will be periodically instructed in fire prevention and protection measures. This will include squadrons on temporary duty.

Personnel engaged in duties incidental to aircraft operations (maintenance, refueling, and servicing) on the flight line will be instructed in the types of extinguishers and their operation, care, and proper application with reference to the following types of fires:

1. Aviation fuel fires.
2. Compressor compartment fires.
3. Accessory section fires.
4. Aft fuselage fires.
5. Aircraft wheel and brake fires.
6. Tailpipe fires.
7. Tire fires.

TRAINING PROGRAM. — A comprehensive training program should include instruction and training in the following:

1. Firefighting and rescue organization outline.
2. Aircraft emergency mobilization procedures.
3. Fundamentals of combustion, fire control, and extinguishment; particularly as involved in aircraft fuels, materials, and explosives.
4. Firefighting operations and tactics.
5. Aircraft identification, arrangement, and characteristics familiarization.
6. Basic rescue and first aid procedures.
7. Actual burning practice in simulated aircraft fire emergencies.
8. Review and discussion of past accident operations.
9. Fire hazards involving aviation fuels.
10. Preparation and submission of aircraft/rescue reports.
11. Driver-operator instructions.
12. Ordnance. (The Ordnance/Weapons Officer will give special instructions on ordnance in accordance with the activity's mission and facilities supported.)
13. Characteristics of commercial jet aircraft which, in the event of an emergency, may land at Navy or Marine Corps air facilities.

TRAINING AIDS.—Applicable training manuals, directives, films, visual aids, and other material published by the Government departments and aircraft manufacturers should be utilized to the maximum extent in the training program. Results of actual tests, personal experiences and observations, and knowledge of specific characteristics of various types of aircraft should be incorporated into local fabricated training aid devices, demonstrations, and charts to augment published manuals. Aircraft familiarization kits, charts, and cutaways are valuable training aids. Local medical, aircraft maintenance, ordnance, operations, and other related services should be enlisted to cooperate in conducting appropriate training phases.

An adequately planned and suitably located training ground for actual burning practice and simulated crash operations is essential at each naval air activity. In developing each training grounds site, due consideration should be given to location with respect to the airfield, to assure noninterference with flying operations and, at the same time, to provide rapid availability of the personnel for emergency response.

Training fires and realistic forcible entry into and rescue from burning aircraft should be used to the extent necessary to attain and maintain the desired standards of proficiency.

Emergency Communications System

The emergency communications system must be reliable and rapid. The system should include crash firefighting and rescue crews, crash ambulance crews, and other personnel and activities requiring notification. It should also provide communications between mobile emergency units and control fixed stations.

Radio Equipment. Radio equipment is allocated for specific use of aircraft fire/rescue organizations. The aircraft fire/rescue network is for emergency communications ONLY, and is not to be used for any other reason such as administrative or industrial purposes. Fixed transceivers are authorized for the following:

1. Aircraft control tower.
2. Aircraft fire/rescue alarm room (crash shack).
3. Structural fire station where structural and aircraft fire/rescue units are not housed in one common structure.

The following mobile transceivers for the fire/rescue network are authorized:

1. Aircraft fire/rescue trucks or vehicles.
2. Fire chief's vehicle; dual installation on the aircraft fire/rescue network and internal security or other fire network.
3. Crash ambulance.
4. Runway foamer/nurse truck.
5. Rescue boats (if applicable).
6. Other vehicles that the commanding officer deems necessary to support aircraft fire/rescue and/or salvage operations.

NOTE: Suitable portable or mounted mobile equipment should be provided in sufficient quantity to enable communications between the crash vehicle convoy and SAR (Search and Rescue) boats and/or aircraft when operating within the range of the control tower or the crash communications control station.

Primary Aircraft Emergency Alarm Intercommunications System.—The PRIMARY crash alarm system, in addition to the radio equipment described above, consists of a direct wire communications system installed at the following locations:

1. Aircraft control tower.
2. Air operations dispatcher.
3. Aircraft fire/rescue alarm room (crash shack).
4. Structural fire organization alarm room.
5. Air operations duty office.
6. Station hospital or dispensary.

The purpose of this system is to afford an immediate means of communications to primary emergency activities, and to notify the operations dispatcher so that he may in turn notify all essential supporting activities.

Secondary Aircraft Emergency Alarm Intercommunications System.—This system may operate through the regular telephone switchboard, and the commanding instrument is generally located at the operations dispatcher's desk. Instruments on this system are installed as required at specific locations, thus permitting notification of all essential personnel and activities simultaneously by the operations dispatcher without interference with control tower or primary crash alarm operator's duties.

Stations served by the crash alarm telephone system are variable and at the discretion of the commanding officer. The following connected stations are suggested:

1. Crash-rescue alarm room.
2. Structural fire station.
3. Hospital or dispensary.
4. Photographic laboratory.
5. Aircraft maintenance department.
6. Crash boat house (if applicable).
7. Security Office.
8. Airfield operations office, which in turn notifies by regular telephone or other means:
    a. Aircraft accident board members.
    b. Aviation safety office.
9. Duty officer's office, where by regular telephone or other means the following personnel are notified:
    a. Commanding officer.
    b. Staff officers as required.
    c. Chaplain.
    d. Information services officer.
    e. Other agencies whose presence at an aircraft accident is declared necessary by the commanding officer.

It is the responsibility of the control tower to observe and report emergencies to the crash crew. This does not relieve crash crews ON RUNWAY ALERT of the responsibility for maintaining constant observation since, particularly during active flying periods, many instances may escape the initial notice of the tower operator. Crash crews dispersed on alert assignment or actual response will monitor the crash communications control center, or air traffic control tower, as appropriate.

In the event of a crash or notification of impending emergency, on or off base, upon which the tower operator received initial notice, he immediately notifies listening members of the crash crew by radio or over the primary crash intercommunications system, consistent with circumstances. As far as can be ascertained, the crash crew, including ambulance, is furnished complete information concerning location, type of aircraft, occupants, type of cargo carried (especially if any explosives are aboard), amount of fuel aboard, nature of the emergency, landing runway and time, and such other information as is pertinent to the anticipated emergency operation. This information may be obtained by monitoring air traffic control and by tower operator's repeatback. Upon receipt of initial notification, crash crews and ambulance respond immediately and, if the incident is an impending emergency, they assume standby positions at predetermined emergency locations alongside, but clear of designated runway.

Simultaneous with notification of crash truck and ambulance crews, the operations dispatcher is notified over the primary crash intercommunications system. The operations dispatcher then notifies other designated activities over the secondary crash intercommunications system.

If information of a crash or emergency is received by the crash crews or operations dispatcher before the control tower, the tower operator is immediately notified by radio or intercommunications system, and crash fire-fighting vehicles and ambulance proceed to the crash or emergency location.

Maintenance of Alert

It is mandatory that aircraft firefighting and rescue crews, with ample equipment, be maintained on an ABSOLUTE alert status during all scheduled periods of recurrent flying activity. The location of the alert station will vary between naval air activities and with circumstances.

1. Runway Alert. A runway alert must be maintained at all times that runways are in use to provide timely rescue of personnel involved in unanticipated emergencies, and to report any suspected malfunction of aircraft to the aircraft control tower. This runway alert must be strategically located in order to observe the entire runway in use and respond immediately to an emergency.

NOTE: Where landings and/or takeoffs are being conducted simultaneously, or where more than one runway is in use and operations cannot be observed from a single vantage point, a second runway alert is required.

The runway alert must consist of a fully manned MB-5 or, where an MB-5 is not available, a truck-mounted twinned agent unit (TAU) with a crew of four men may be utilized as a interim measure. At air activities where the aircraft maximum gross takeoff weight is 10,000 pounds or less (table 4-1, gross weight

Table 4-1.—Minimum response requirements

| Aircraft maximum gross takeoff weight in pounds | Gross weight category | Gallons and pumping rate of water for foam generation—AFFF—GALS/GPM |
|---|---|---|
| Up to 10,000 | 1 | 400/250 |
| 10,000 to 60,000 | 2 | 800/500 |
| 60,000 to 90,000 | 3 | 1200/750 |
| 90,000 to 200,000 | 4 | 1800/1000 |
| 200,000 and over | 5 | 2400/1250 |

NOTE: This table supersedes minimum response requirements as set forth in NAVAIR 00-80R-14, U.S. Navy Aircraft Firefighting and Rescue Manual, dated 1 January 1968.

category), the TAU with a crew of four men may be used as the runway alert in lieu of the MB-5.

Runway alert watches may be established in a number of watch hour combinations, dependent upon intensity of operations and weather conditions. No one fire/rescue crewman, however, is to be assigned to runway alert duty for more than a total of 8 hours in any one 24-hour period.

2. Standby Alert. The purpose of the standby alert is to supplement the runway alert in meeting minimum response requirements, and to provide firefighting capability required to minimize danger to flight personnel, and to reduce fire damage to aircraft involved in an accident. A standby alert must be maintained at all times during flight operations and will consist of an ambulance, MB vehicles, and runway foamer. Where the combined fire organization is located in common quarters, or the structural fire station is so located as to permit response within the time prescribed for standby alert (3 minutes from the standby position to the field alert position), one MB-5 and/or the runway foamer will be cross manned by personnel normally assigned structural firefighting duties. However, at least one structural fire pumper must be maintained in a fully manned condition at all times to permit ready response to structural fire emergencies.

On notification of an anticipated or impending emergency landing, the standby alert must assume the condition of readiness of the runway alert at a strategic position near the anticipated emergency location.

3. Backup Standby Alert. During flight operations, a backup standby alert consisting of other medical/ambulance personnel, ordnance disposal teams and vehicles, and the structural fire organization must be maintained in a condition of readiness that will permit prompt response from normal working areas to a standby alert position. On notification of an emergency or other anticipated aircraft malfunction, these forces will assume the condition of readiness of the standby alert and await instructions from the senior fire officer at the scene of the emergency.

4. Mutual Assistance. In addition to the support and utilization of the structural fire crews and equipment, cooperation and mutual assistance between Department of Defense Agencies and between Naval and Marine Corps activities are essential. Coordination and cooperation between local military, civilian airport, and municipal firefighting organizations are encouraged. Local commanders are enjoined to cooperate with forest service, state, and local fire officials in developing plans to furnish mutual assistance to an extent which would not impair the safety of the military facility involved.

5. Minimum Response. Table 4-1 contains the minimum response necessary to adequately perform the aircraft fire/rescue function for routine flight operations. This table establishes minimum response in number of gallons and pumping rate based on use of the fire extinguishing agent, AFFF (Aqueous Film Forming Foam). This is the standard extinguishing agent used by the Navy. (Protein foam is still used for runway foaming operations.)

If for any reason the minimum response water requirements cannot be provided by the runway and/or standby alert as specified in the preceding paragraphs, the commanding officer concerned should curtail or reduce flight operations to a gross weight category of aircraft for which the water available meets minimum response requirements.

6. Aircraft Firefighting and Rescue Vehicles. The type and quantity of crash/rescue vehicles assigned will vary with the operational status of the air activity. Assignments are made on the basis of the mission of the airfield and the actual number and types of aircraft. The number and types of crash/rescue vehicles assigned an activity are based on the minimum response requirements. More vehicles may be assigned to allow for repair and maintenance and for exceptionally hazardous and/or intense flight operations. The MB-1 and MB-5, using AFFF fire extinguishing agent, are the standard aircraft fire/rescue vehicles. In addition to the MB equipment, some selected air activities, which support aircraft with costly and intricate electronic equipment, have been provided a 06 carbon dioxide vehicle. This vehicle must be maintained as part of the standby alert and manned with minimum response requirements.

7. Support Crash/Rescue Vehicles. Supporting aircraft fire/rescue vehicles include the following:

a. Auxiliary aircraft fire/rescue trucks. These are small lightweight vehicles of the multidrive type and may be equipped with assorted power and hand-operated forcible entry tools and/or field lighting equipment. A truck-mounted TAU with the above equipment may be substituted for this support vehicle.

b. Water tankers/runway foamer. Runway foamer trucks may be assigned to or be on emergency call for service with the aircraft fire/rescue organization. Runway foamers may also be used to transfer water and/or fire extinguishing agents to other firefighters/crash rescue trucks, in the event such a transfer becomes necessary.

c. Structural fire pumpers and brush fire trucks. Structural fire pumpers and brush/structural fire trucks may be utilized to back up aircraft fire/rescue trucks. Particular benefits will be derived where installed water distribution systems, or sources of a static body of water are available with hose line relay distances. In addition to regular functions, brush/structural fire trucks should be used to respond to off-base aircraft emergencies.

d. Navy airlift type, dry chemical extinguisher, 400-pound capacity, Purple-K-Powder (P-K-P) extinguishers mounted on four-wheel drive, 3/4- to 1-ton pickup trucks equipped for crash/rescue operations.

NOTE: These units will be phased out and replaced as necessary with TAUs.

e. Crash ambulance. The medical officer is responsible to the commanding officer for the assignment of proper equipment and personnel for crash ambulances. Each ambulance on call for aircraft crashes should have equipment sufficient to provide adequate care for several injured persons. Crash ambulance crews should include at least one enlisted man, preferably a Corpsman trained in crash-rescue work and first aid, who also may act as the driver. At least one crash ambulance with crew should be ON STANDBY ALERT during scheduled flying hours and at such other times as designated by the commanding officer.

f. Aircraft salvage cranes. Mobile cranes (40- to 50-ton capacity) and truck-mounted (10- to 20-ton capacity) should be available to expedite aircraft salvage and/or rescue operations.

g. SAR (Search and Rescue), helicopters, and boats, where available.

8. Personnel Requirements.

a. Runway alert. The number of personnel assigned to MB-5 and TAU vehicles used on runway alert, as previously set forth in this chapter, is predicated upon those personnel required to drive and to operate the vehicle firefighting system, and simultaneously perform rescue functions.

b. Standby alert-immediate (3-minute) availability. The following personnel are essential for immediate participation in emergency operations:

(1) Fire chief, as available, the on-duty assistant fire chief, and/or the aircraft fire captain on duty.
(2) Fire-rescue crews.
(3) Ambulance crew.
(4) Personnel for runway foamer.

(5) Aircraft SAR boat crew at those activities situated so that availability of such boats is required.

(6) SAR helicopter crew (if available).

c. Support participation. The following personnel are required to provide support for aircraft fire/rescue and salvage operation:

(1) Aircraft maintenance personnel.
(2) Security personnel.
(3) Official photographic personnel.

d. Administrative participation. The following are required to be present at an accident site:

(1) Accident board members.
(2) Aviation safety officer.
(3) Such other personnel as the commanding officer deems necessary.

Manpower

It is essential that sufficient personnel be assigned to the aircraft firefighting/rescue organization to perform all assigned duties/functions. With exception of the runway alert vehicle (described previously), the following is established as the minimum number of on-duty personnel required for manning the standard fire/rescue vehicles:

| | |
|---|---|
| MB-1A | 5 personnel |
| MB-1 (Old) | 5 personnel |
| MB-5 | 4 personnel |
| Truck-mounted TAU | 2 personnel |
| Nurse truck or combined foamer nurse truck | 2 personnel |
| 06 carbon dioxide truck (where provided) | 2 personnel |

The manpower criteria as directed by NAVMAT Instruction 11320.11, Aircraft Fire Fighting and Rescue Service, provides manning under the following specific conditions:

1. Continuous operations, with respect to hours of operations.
2. Normal operations, with regard to degree of hazard and intensity of flight operations.
3. With crews trained to fully utilize equipment/vehicle capabilities.

Some deviations from these specific conditions are to be expected. Commanding officers are enjoined to utilize the services of the area fire marshal and the station fire chief to establish an aircraft fire/rescue unit that realistically supports the station's mission.

HOURS OF OPERATION.—The majority of air activities are open to flight operations 24 hours a day, 7 days a week, and firefighters are employed on an average 72-hour workweek. A multiple factor of 2.7 men must be used to compute the number of personnel required to man a minimum response position 24 hours a day, 7 days per week. Some auxiliary landing fields, and outlying fields, are not operated 24 hours per day. As the hours of operation for which the fire/rescue function must be provided decreases from the 24-hour day to an 8-hour day, 40-hour week, the multiple factor decreases to 2.35 for a 65-hour week, to 1.65 for a 50-hour week, and to 1.1 for a 40-hour week.

NOTE: Multiple factors cited apply only to personnel required to man aircraft fire/rescue vehicles necessary to meet minimum response requirements.

One aircraft fire captain (supervisor) for each section is required in addition to the above listed personnel. If other duties such as maintenance and operation of arresting gear or FLOLS, wheel watches, salvage crane operation, mess cooking, or compartment cleaning are assigned to the fire organization, additional personnel must be assigned in consonance with the requirements for such other duties.

EXTRA-HAZARDOUS FLIGHT OPERATIONS.—Extra-hazardous flight operations are those other than routine flight operations which, for reasons of training, intensity, and/or number of aircraft involved, increase the frequency of aircraft accidents. Examples of extra-hazardous flight operations are: any portion of the progressive phases of flight training where instructors are not available to the student, field carrier landings, combined squadron and/or airwing flight operations, aircraft with hospital litter cases aboard, aircraft involved in test and/or evaluation, and remotely controlled aircraft flight operations.

INTENSITY OF FLIGHT OPERATIONS.—The intensity of flight operations varies at air activities to well over 100,000 flight operations per quarter (fiscal). As the intensity of flight operations increases, the base loading of aircraft is increased. This imposes greater requirements for flight line fire prevention and protection efforts and increases the demands on the aircraft fire/rescue organization. The foregoing may dictate to the supervisor the necessity of increased manning levels.

ASSIGNMENT OF PERSONNEL.—Care must be exercised in assigning military personnel to aircraft fire/rescue duties. These men should be in good physical condition, be resolute, and possess initiative and a capability to assess a fire situation. The following standards meet the above criteria:

1. Driver/operators of emergency aircraft fire/rescue equipment must be 21 years of age or older. However, this requirement will be waivered down to 19 years of age for qualified graduates of the Aviation Crash Crew School, NATTC, NAS Memphis, Millington, Tennessee, or the Aviation Boatswain's Mate H (Aircraft Handling) Course, NAS, Lakehurst, New Jersey, provided that emergency fire/rescue equipment driver training requirements set forth by NavFac Instruction 11240.82 (Series), Policy and Procedures for the Testing and Licensing of Motor Vehicles, have been met.
2. Education—a minimum of 2 years of high school education.
3. Size—at least 5 feet 8 inches in height and weight of at least 160 pounds, well proportioned, and better than average strength and agility are essential.
4. Assignments should be for a 2-year period with a well-planned program for replacements in order to preclude sudden transfers of large numbers of experienced personnel. At least one-half of the on-duty personnel should have a minimum of 8 months' experience in the assignments.

## AIRCRAFT CRASHES

Many variables are involved in aircraft emergencies that require immediate, positive, and accurate judgement with regard to response routes and firefighting tactics. As time is all important in effecting rescue of personnel, it is imperative that the responding crash firefighting vehicles be employed to effect the rescue as rapidly as possible. Once committed, time does not permit the redeployment of vehicles. The intensity of the operation and the full attention of personnel to combating fires and effecting rescue do not permit individual direction of personnel. In addition, the geographical location of the station, obstacles, terrain, and field layout differ for each activity. Therefore, it is necessary that each aircraft crash firefighting organization preplan its actions so that all personnel are familiar with a basic plan of action. It must be remembered that preplanning is basic, and that conditions upon arrival at the scene may require adjustment to cope with the situation. The factors involved in preplanning and tactics employed at the scene are dependent upon the following:

1. Terrain.
2. Wind direction.
3. Type of aircraft involved.
4. Crew stations within the aircraft.
5. Fire location on the aircraft and/or degree of fire involvement.
6. Presence and type of ordnance stores.
7. Type of primary extinguishing agent dispensed by the responding vehicle(s).

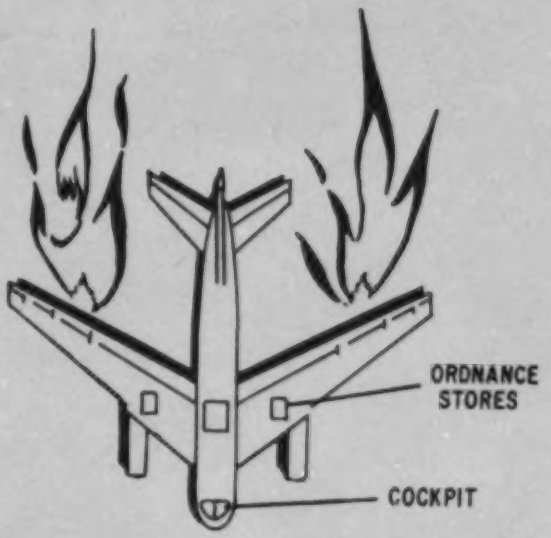
When aircraft crash firefighting personnel respond to the scene of an emergency, they must have all information available to enable them to plan their attack intelligently and effectively. The aircraft control tower will transmit as much of the following information as is available:

1. Location of the aircraft emergency.
2. Type of aircraft.
3. Number of occupants.
4. Presence and type of ordnance aboard.
5. Fuel state, if known.
6. Any other amplifying information.

Speed is the essence of successful aircraft firefighting. A few seconds' difference may mean the saving of a life or the saving of an aircraft. Although the aircraft firefighter is highly trained and motivated toward speed of response and rescue of personnel, the speed of responding vehicles must be within the safety

limitations of the vehicle. In short, the vehicle and rescue crew must arrive at the scene to accomplish their mission. The speed of the vehicles in response to an accident must be that at which the vehicle may respond and maneuver safely.

Normally the first aircraft crash/fire-fighting vehicle to arrive at the scene of an aircraft accident will be the runway alert vehicle. The responsibility for success of the rescue/firefighting operations rests heavily upon the first response vehicle. The driver-operator of the first response vehicle sets up the rescue/firefighting operation at the scene, and his decisions must be made accurately and on a split second basis. The first response vehicle sets up the initial path for the rescuemen and controls the fire in the control area. All other crash firefighting vehicles arriving at the scene must take position complementing the first response vehicle, enlarging on the pattern for rescue and total extinguishment. It must be borne in mind that all factors involved in aircraft crashes cannot be discussed in detail, as each accident will present many variables. The basic approach is that which will afford the most efficient control of fire in the area, or locations where rescue of personnel is to be performed. Due to prevailing conditions, these basic procedures may not be adaptable in their entirety, and may require deviations to accomplish the mission. The following paragraphs are points of consideration, not necessarily in their sequence of importance.




Note:

Control the area encompassing personnel locations and, if involved, ordnance stores stations. In the case of guns, rockets or missiles adjust to remain clear of the line of fire.

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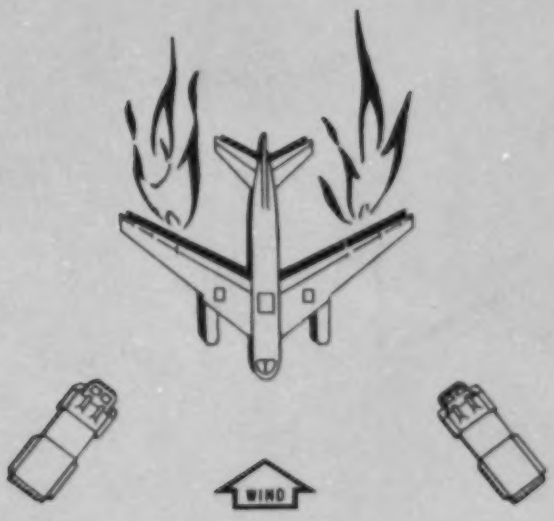
Figure 4-1.—Fire control area.

Type of Aircraft.—The type and size of the initial fire control area will be dependent upon the type of aircraft, the number of personnel aboard, and their stations aboard the aircraft. Locations of access doors, hatches, and canopies must be considered, as well as obstacles and aircraft design features that may impede the rescue effort.

Basic Vehicle Spotting.—The basic vehicle position, in relation to aircraft involved in an accident, is at the nose or tail of the aircraft. For aircraft in total fire involvement, this position affords the most advantageous location to provide coverage in the control area along both sides of the fuselage. (See fig. 4-1.)

Use the Wind.—The wind must always be used to your advantage, unless conditions dictate otherwise. Position vehicles and attack from upwind, with the wind to your back or on the quarter if possible. The seat of fire cannot be identified through smoke on the downwind side. When attacking a fire from the upwind approach, firefighting personnel are not subjected to the same intensity of heat as from a downwind approach. In addition, fuel vapors will drift away on the wind, whether ignited or not. (See fig. 4-2.)

On combat aircraft carrying rockets, missiles, or other ordnance stores containing rocket motors, the basic vehicle's spotting position will have to be adjusted to keep from being in the line of fire or exhaust blast areas in case the rocket motors are set off by heat from the fire. In this case the attack would be from the quarters, with attention directed

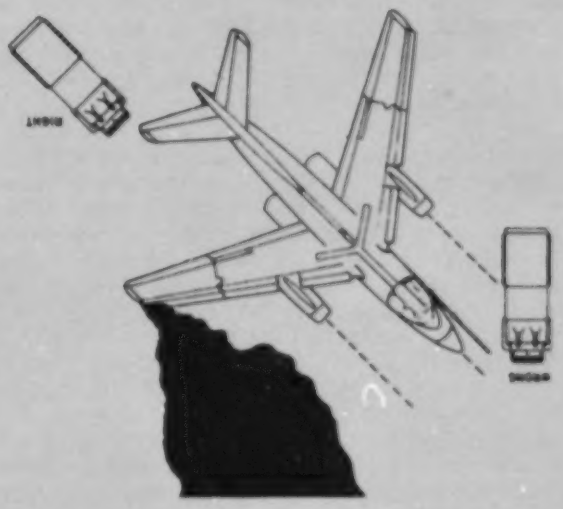



200.14

Figure 4-2. — Use of wind direction to best advantage.

toward expanding the control area to encompass rockets, missiles, or other ordnance stores containing rocket motors located in or on the aircraft, as well as entrapped aircrew locations. In combating a fire on aircraft with ordnance stores that do not contain rocket motors, the initial attack should include, in the control area, the location of ordnance stores on the aircraft. When fixed guns are contained in the aircraft, the basic nose or tail spotting position will require adjustment to preclude vehicles or personnel from being in a direct line of fire from this type of weapon. (See fig. 4-3.)

Seat of Fire.—The fire should be attacked to prevent spread, and to drive the fire outward from the aircraft or in a direction least hazardous to aircraft and crew. The fire is not to be driven toward the fuselage or ordnance stores locations. Plan your attack for control and extinguishment; and in your line of attack, do not oppose one another (more than one fire and rescue vehicle). Know the terrain surrounding the airfield; and in response, choose the ground that affords assurance of your arrival on the scene.



200.15

Figure 4-3. — Beware of ordnance stores.

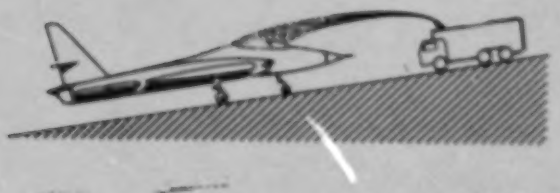
Get Into Range.—Firefighting vehicles must be in effective range, with sufficient additional handline length for maneuvering. Position the vehicle to afford all firefighting appliances their maximum capabilities. (See fig. 4-4.) Liquid fuels or vapors flow with ground slopes, and may flow toward the crash/rescue vehicle if on a lower elevation than the source. Stay uphill, even though the elevation may be on the edge of a slight depression. (See fig. 4-5.)

In the event that it becomes necessary to move crash/rescue vehicles during firefighting operations, each vehicle should be positioned to permit movement in at least one direction. Support equipment must not be allowed to be positioned whereby movement of the crash firefighting vehicles is prevented.

Rescue.—All aircraft crash/rescue vehicles and personnel must cover rescuemen during the entirety of the rescue operation. Even though total extinguishment may have been accomplished, vehicles and personnel hold their positions for instantaneous action in the event of reignition. Rescuemen face aft, keeping eyes on ejection seat and ejection seat controls while lifting injured or unconscious personnel out of attack or fighter aircraft. NOTE: Crew entrapment is discussed in a later section of this chapter.

200.16

Figure 4-4.—Get into fire range.



200.17

Figure 4-5.—Attack fire from uphill vantage.

Attack

The attack on the fire commences as soon as the vehicles are within range of the fire, and as close to the aircraft as safety will permit. On MB type vehicles, the turret operators are in firefighting position well in advance of arrival to the scene if the accident occurs in the vicinity of the runways. Turret operators adjust the turret from straight stream to spray patterns, depending upon reach required and pattern desired, and using as much spray as possible to cover a large area. Sweeping the turret from side to side contributes to coverage of a large area in a short period of time.

The main objective is to knock down the mass of fire in the vicinity of the fuselage (fire control area) to permit immediate rescue; then concentrate on working the remaining fire areas over by appropriate pattern adjustment. The turret nozzlemen will be directed to shut off the turrets when the fire has been checked in the control area, and will keep one hand on the shutoff valve and the other hand on the turret handle in readiness for instantaneous action. Handlines will be utilized to extinguish small fringe and/or patch fires that may exist after turret shutdown.

The boom and ground-sweep nozzles of the 06 type aircraft crash/rescue vehicle are activated when in effective range of the fire, with the boom directed toward the fuselage of the aircraft and the ground-sweep nozzles covering the area in front of the vehicle. The $CO_2$ is dispensed until the fire is extinguished, and handlines are utilized for extinguishment and standby to combat reignition. $CO_2$, being a gas, is dispersed into the atmosphere and is carried from the fire area by the wind and, therefore, does not possess the capability of preventing backflash. It is imperative that personnel be extremely alert and be prepared immediately to combat backflash. When available, use foam to cover the fire area to prevent the possibility of a backflash (reignition).

The vehicle-mounted twinned agent unit (TAU) provides Purple-K-Powder dry chemical for quick extinguishment of aircraft fuel fires and the application of light water to blanket or cover the fuel, preventing backflashes. The vehicle approaches from upwind, and is positioned approximately 40 feet from the fire. The vehicle is so positioned to facilitate pulling nozzles and hoses from the side. Avoid possible kinks in the hose. The nozzleman advances toward the seat of the fire, directing P-K-P at the base of the fire. When headway on the fire is gained, the nozzleman advances, making a rescue path by sweeping from left to right, with both P-K-P and light water nozzles operating. When sweeping from left to right, the light water nozzle is off, and as the sweeping changes from right to left, both nozzles are activated. The fast action of the P-K-P and the excellent holding qualities of light water will allow the nozzleman to advance rapidly and open a path for the rescueman/men to accomplish the rescue. After the rescue path has been opened, the nozzleman continues to extinguish fire that might hinder rescue or, if rescue has been accomplished, he continues toward total extinguishment. A trained and

AIRCRAFT FIRE/RESCUE REPORT
BAYWEPS FORM 11135/1 (REV. 11-63)

NO TRANSMITTAL LETTER REQUIRED

REPORT SYMBOL BAYWEPS 11135-1

| | | |
|---|---|---|
| STATION AND LOCATION: Naval Air Station Memphis, Tennessee | DATE OF REPORT: 10 May 19 | AFSN NO.: 3-7 |
| | DATE AND TIME OF INCIDENT: 9 May 19 1306 | ON STATION: X / OFF STATION: |
| REPORTING CUSTODIAN: N.A.S. Memphis, Tennessee | MODEL AIRCRAFT INVOLVED: A4F | BUREAU NO.: 154970 |

TO: Chief, Bureau of Naval Weapons

VIA — MILITARY COMMAND: CNATECHTRA, Memphis, Tennessee — SIGNATURE: C.T. Meyers

EXACT LOCATION OF INCIDENT: 130' off the approach end of R/W 21 on taxiway 30' from west edge of taxiway

| TYPE OF INCIDENT | | | | | | | | FIRE INVOLVED | | ESTIMATED CAUSE |
|---|---|---|---|---|---|---|---|---|---|---|
| TAKE-OFF | X | LINE OR LOADING | | FUELING | | | | YES | X | Aborted takeoff. |
| LANDING | | PARKED | | MAINTENANCE | | | | NO | | |
| TAXIING | | DEFUELING | | INFLIGHT | | | | IMPACT EXPLOSION | | Brakes overheated. |
| OTHER (Specify) | | | | | | | | DELAYED EXPLOSION | X | |

CONDITIONS AT TIME OF INCIDENT

| GENERAL WEATHER PICTURE | | NATURE OF TERRAIN AT AND IN APPROACH TO INCIDENT |
|---|---|---|
| Clear 20 miles | WIND DIRECTION: 173° | Taxiway is concrete. |
| | WIND VELOCITY (mph): 5 | Terrain is rolling hills. |
| | TEMPERATURE (°F): 59 | |

LIQUID FUEL QUANTITY

| | | OTHER FUELS |
|---|---|---|
| ESTIMATED ON BOARD BEFORE INCIDENT (lbs) | 9100 | None |
| ESTIMATED ON BOARD AFTER INCIDENT (lbs) | 8900 | |
| ESTIMATED SPILL AREA (Size in feet) | Hydraulic fluid 6 ft. | |

PERSONNEL RESCUE

| | | DESCRIBE RESCUE METHODS USED |
|---|---|---|
| NO. PERSONNEL ON BOARD AIRCRAFT | 1 | None required. |
| NO. PERSONNEL SURVIVED | 1 | |
| NO. PERSONNEL ESCAPED UNAIDED | 1 | |
| NO. PERSONNEL RESCUED | 0 | |

FIRE FIGHTING

| FIRST METHOD OF ALARM USED | | | | | | TIME RECORD | |
|---|---|---|---|---|---|---|---|
| TWO-WAY RADIO | X | EMERGENCY INTER-COM. | | EMERGENCY PHONE | | TIME ALARM RECEIVED | 1306 |
| OTHER METHOD (State) | | | | | | TIME EQUIPMENT ARRIVED | 1307 |

STATION EQUIPMENT

| EACH EQUIPMENT AVAILABLE AT INCIDENT | | NO. PERSONNEL MANNING EQUIPMENT | | QUANTITY EXTINGUISHING AGENTS USED | |
|---|---|---|---|---|---|
| TYPE | NO. LOADS USED | MIL. | CIV. | FOAM (gals. conc. used) | OTHER TYPES AND QUANTITIES |
| MB5 | 0 | 2 | 2 | | PKP 1-30 pounds |
| MB5 | 0 | 2 | 2 | | |
| MB1 | 0 | 1 | 4 | | PKP 1-30 pounds |
| Crash P/U | 0 | 0 | 1 | | PKP 1-30 pounds |
| Nurse truck | 0 | 1 | 1 | | |

STATION EQUIPMENT OUT OF SERVICE

| TYPE | DEFICIENCY | NO. OF DAYS | EXPLAIN DELAYS TO REPAIR |
|---|---|---|---|
| MB5 | Engine block cracked | 45 | Cannot repair - New engine not available this date |

200.18

Figure 4-6.—(A) Aircraft fire and rescue report form.

experienced nozzleman can extinguish, and hold 2,400 square feet of fire area.

Reports and Grid Map

Within 72 hours following an aircraft emergency, the activity to which the crash/rescue organization is attached will submit a report of the incident on NAVWEPS Form 11135/1. (See fig. 4-6.)

Reportable emergencies are those in which the crash/rescue crew performed rescue, firefighting, or salvage operations. It is imperative that the report be a complete and accurate description of the incident, including conditions, difficulties, and action taken. Of particular importance is information regarding the usage and performance of extinguishing agents and equipment. It is from these reports that the Naval Air Systems Command can determine program effectiveness and evaluate agent and equipment performance. Accurate reporting is a vital aspect to the crash/rescue program.

Report Routing.—The original of the report should be forwarded to the Commander, Naval

FULL DESCRIPTION OF FIREFIGHTING OR PROTECTION AT INCIDENT

At 1306 the tower operator called via the two-way radio and stated an A4F had hot brakes and wheels were on fire. The crash pickup was first at the scene, and upon arriving, found both wheels burning. PKP was applied quickly bringing the fire under control. Other PKP was applied to keep the fire from reflashing, and to cool the wheels. Hydraulic fluid was leaking from both wheels.

The aircraft was kept at the scene for 1 hour after the fire was extinguished to let the wheels cool off, the wheels were replaced, and the aircraft was towed to the hangar.

2

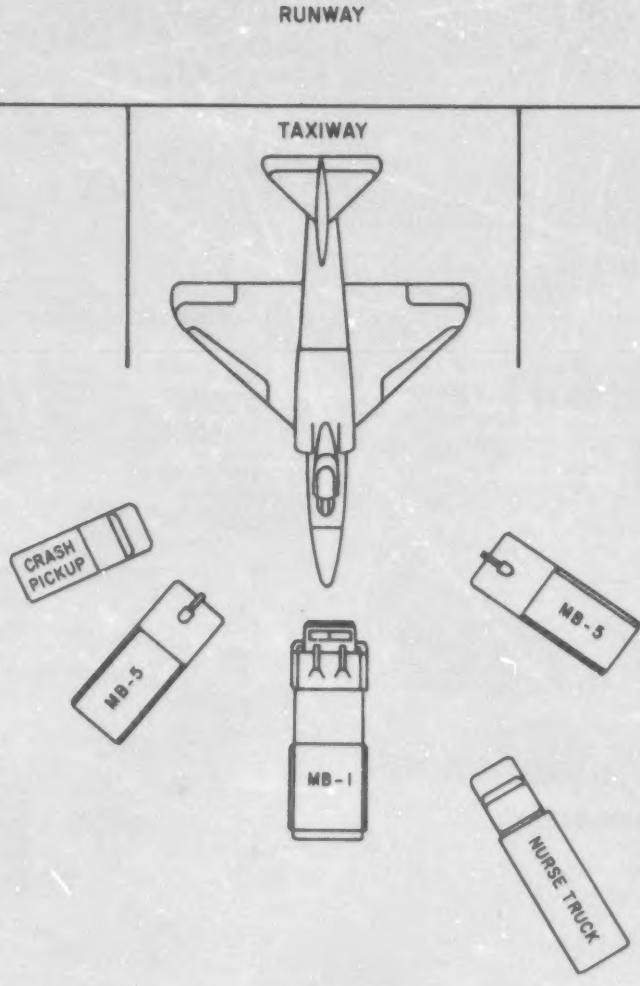
200.19

Figure 4-6.—(B) Aircraft fire and rescue report form—continued.



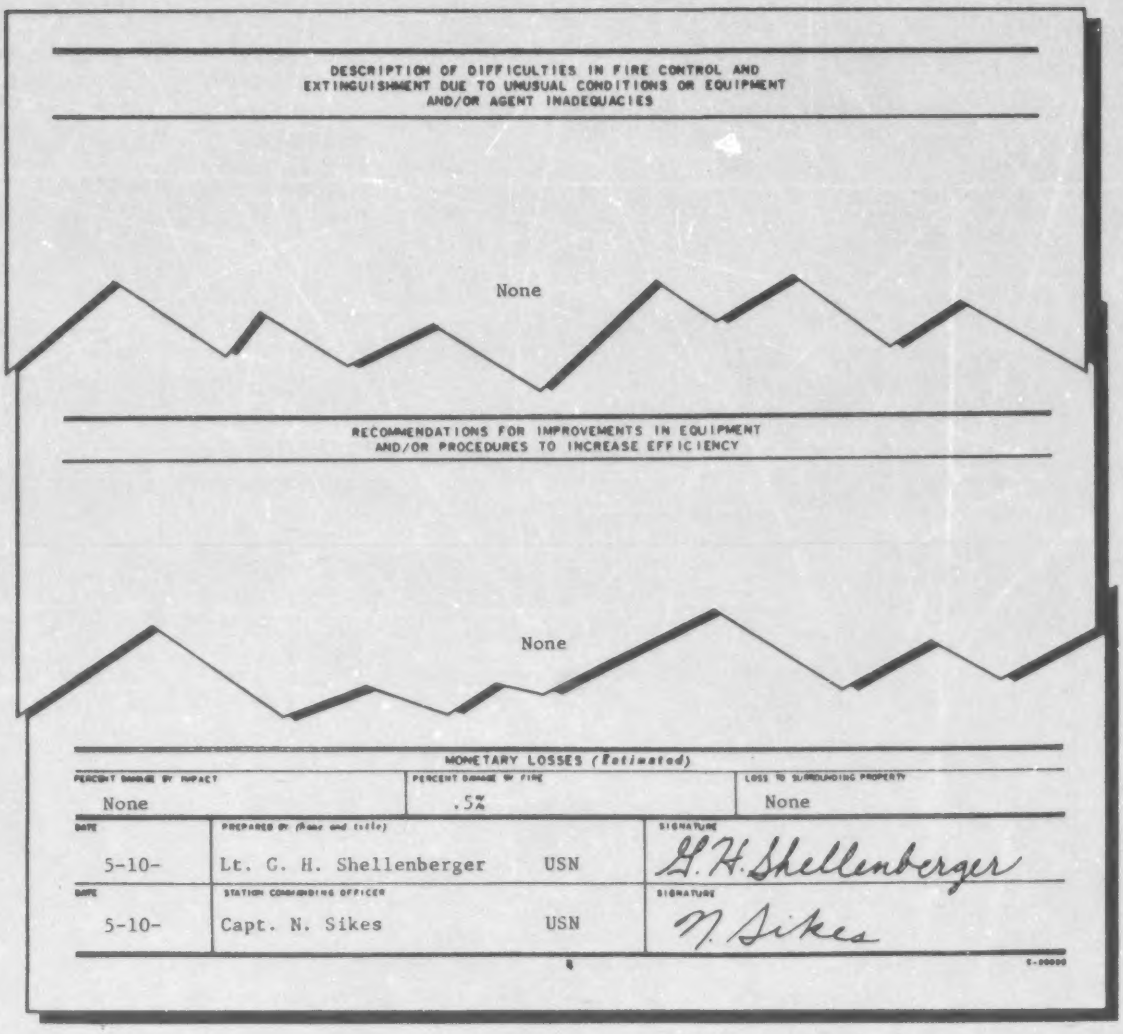
70

DIAGRAM OF INCIDENT SHOWING WIND, DIRECTION, APPROACH OF EQUIPMENT, POSITION OF AIRCRAFT, DISTANCES, ETC.
*(Tape and photographs should be included, if significant)*




200.20

Figure 4-6.—(C) Aircraft fire and rescue report form—continued.



DESCRIPTION OF DIFFICULTIES IN FIRE CONTROL AND EXTINGUISHMENT DUE TO UNUSUAL CONDITIONS OR EQUIPMENT AND/OR AGENT INADEQUACIES

None

RECOMMENDATIONS FOR IMPROVEMENTS IN EQUIPMENT AND/OR PROCEDURES TO INCREASE EFFICIENCY

None

MONETARY LOSSES (Estimated)

| PERCENT DAMAGE BY IMPACT | PERCENT DAMAGE BY FIRE | LOSS TO SURROUNDING PROPERTY |
|---|---|---|
| None | .5% | None |

| DATE | PREPARED BY (Name and title) | | SIGNATURE |
|---|---|---|---|
| 5-10- | Lt. G. H. Shellenberger | USN | G. H. Shellenberger |
| DATE | STATION COMMANDING OFFICER | | SIGNATURE |
| 5-10- | Capt. N. Sikes | USN | N. Sikes |

6

200.21

Figure 4-6.—(D) Aircraft fire and rescue report form—continued.

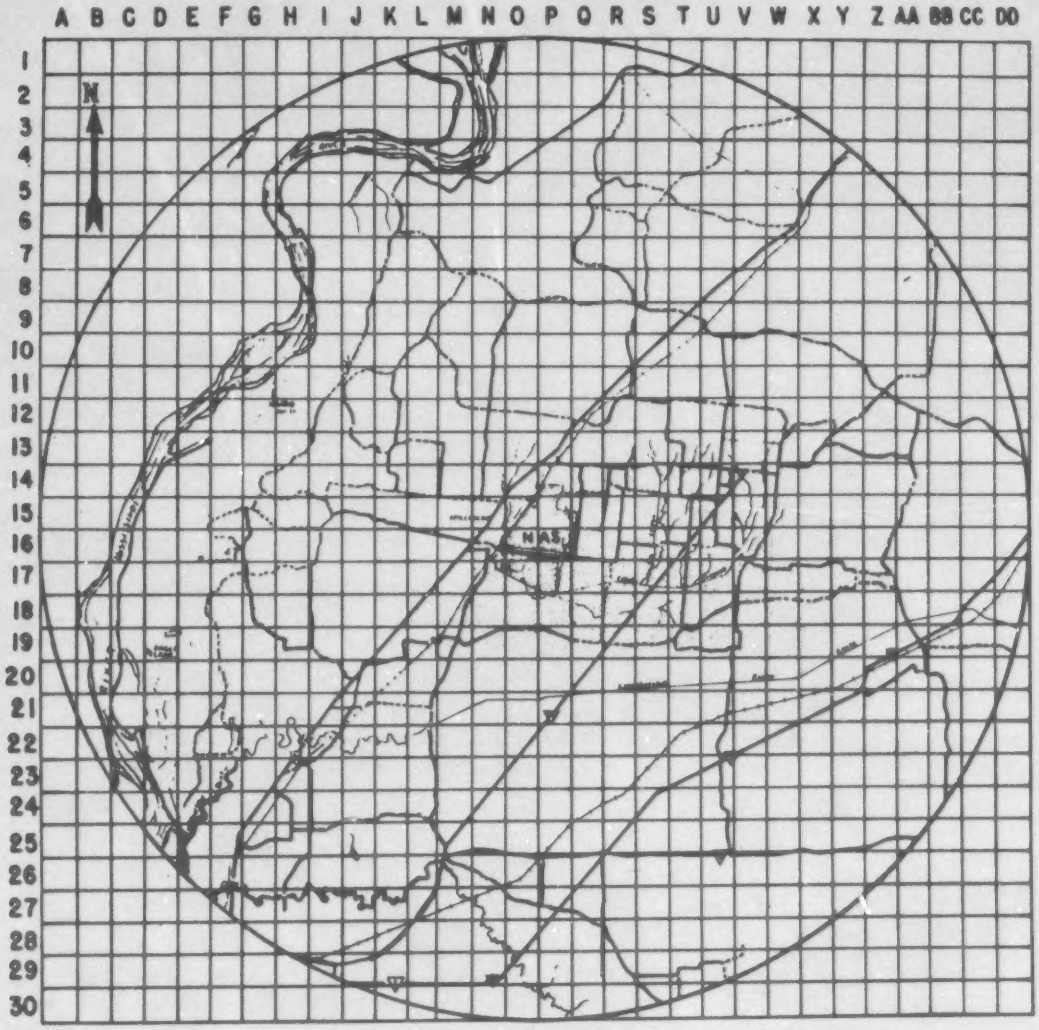
Air Systems Command (Code 423) via the military command. One copy is included as an enclosure to the Aircraft Accident Report, as required by OPNAVINST 3750.6 (Series). This report is sent to CNO via NAVSAFECEN. One copy of the report will be provided for the appropriate district or area fire marshal who is assigned to conduct the annual crash rescue inspection. These inspections are documented on NAVAIR Form 2530. Additionally, and as the occasion requires, technical assistance concerning structural and crash/rescue programs and related subjects may be obtained from the district or area fire marshal.

DAILY LOG.—A daily log or journal must be maintained by each crash/rescue organization. Entries should include all alerts, responses, and other movements of crash/rescue equipment and/or crews, and such other information

as would provide a day-to-day history of crash/rescue business. The fire chief will review and analyze the journal monthly for the purpose of determining adequacy of administrative and operational procedures.

GRID MAP.—A system for locating and reaching an off-the-station crash in a minimum time, with as much crash fire rescue and medical equipment as circumstances warrant, must be employed at each airfield.

A map of the station and surrounding area of approximately a 15-mile radius (the 15-mile radius referred to herein is considered an optimum approximate distance and may be modified to conform to level conditions and terrain) must be maintained at the operations office, air traffic control tower, crash fire and fire stations, hospital, and security office. These maps should be ruled off in numbered grids and marked for easy location of any point within the map area. Figure 4-7 illustrates




200.22

Figure 4-7.—Grid map.

a grid map. Compass headings from the fields should be ruled on the map to facilitate locations of crashed aircraft. Copies of this map must be kept in all vehicles and liaison aircraft that may be sent off the field in the event of a crash. Such maps should be coordinated between all airfield activities in the general area.

All aircraft crash firefighting and crash and hospital ambulance personnel should acquaint themselves as far as possible with terrain surrounding the airfield. Through personal inspection, they must know location of roads, bridges, paths, and other terrain features in a 15-mile radius of the field.

## EMERGENCY AIRCRAFT FIREFIGHTING AND RESCUE TRUCKS

Crash-rescue crews, with equipment, must be maintained on an absolute alert and be in constant readiness for immediate response and action. Costly errors in material and lives have been and will continue to be made by personnel underestimating or overestimating potential and capabilities of personnel and equipment.

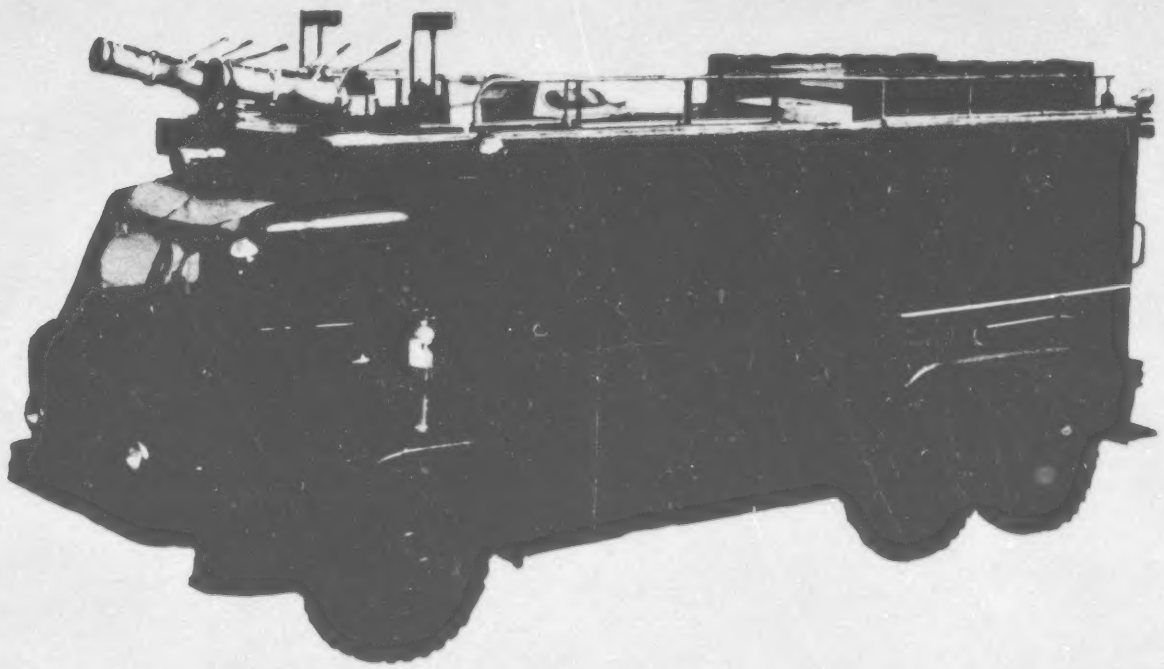
In order for the crash-rescue crewman to make a correct evaluation of any crash situation, he must first have a working knowledge of all equipment available to the crash-rescue crew.

Crash-rescue equipment is uniformly distributed throughout the Navy according to its mission and support requirements.

### MB-1 Trucks

The Navy's MB-1 aircraft firefighting and rescue trucks are its largest and most potent pieces of apparatus. They are designed to move rapidly to the scene of a fire, thus saving lives and property. The two types of MB-1 trucks are described in the following paragraphs.

The Biedeman and Marmon-Herrington (older type vehicles) are mounted on a 6 x 6 chassis, powered by a 320-hp engine. (See fig. 4-8.)



200.23

Figure 4-8.—Aircraft crash firefighting and rescue vehicle (old type) MB-1.

The gross weight is approximately 36,000 pounds consisting of 1,000 gallons of water and 65 gallons of foam concentrate. This type of truck can reach a speed of 45 mph in 33 seconds and obtain a top speed of 64 mph.

The big feature of this truck is its twin independent foam-making systems, each generating 3,000 gpm of high quality mixed foam solution. When properly used, it can cover an aircraft fuselage with an insulating layer of foam and extinguish tremendous areas of aircraft fuel spillage fire. Each of the two identical systems is powered by a 112-hp gasoline engine and completely independent. Both systems may be placed in operation when maximum discharge is needed, or either system may be operated separately. Each turret nozzle is therefore independent of the other.

The turret nozzles used with these separate pumps are of a special design. All foam is fully formed before it reaches the nozzle so it merely acts as a foam distributor. The foam maker pump adds the proper volume of air and discharges the foam forcibly through the turret on the top deck. Remote controls enable the turret operator to open and close valves from the turret position. The turrets may be rotated 360 degrees, elevated 70 degrees, or depressed 20 degrees.

A feature of the turret nozzles is their infinitely variable pattern adjustment, from a solid stream with a range up to 180 feet, to a wide dispersed pattern for close-in work. This feature enables the turret operator to focus constantly on the target with less maneuvering of the truck. Overhead sighting from the top deck enables the operator to place the foam where it will do the most good.

Foam flow is turned on and off by a convenient controller located in front of the turret operator. By means of remote air pressure control, the water and foam concentrate valves are opened and the pump engine throttle advanced to the proper speed. When foam is no longer needed, the controller is returned to the OFF position. An intermediate position produces a water-only turret discharge and is used when only water is needed to fight a fire and also for flushing purposes, after making foam.

There is a separate handling pump system in the MB-1 truck. This system supplies the handline nozzles and the undertruck nozzles with an effective firefighting foam. It is an independent system from the two large foam-maker systems, and this auxiliary handline pump is controlled from the driver's seat. The handline nozzles do a good job of extinguishing smaller fires because they are flexible and easy to handle and are of use chiefly for mop-up operations.

Both the main pump systems and the handline system require cleaning and flushing after each use. The foam concentrate will clog the system and corrode metal parts; therefore, the importance of thorough flushing after each use cannot be overstressed.

Auxiliary equipment carried on the MB-1 crash truck consists of the following items:

Gasoline heater for the engine compartment.
Four search-and-flood lights.
Siren and red light located over the cab.
Revolving red beacon located between the turrets.
Aircraft type power plug located on the rear of the truck.
A two-way radio.

An independent air-cooled gasoline-engine-driven generator provides electrical power for light, radio, etc., during all standby operations. It is not necessary to idle the truck engine for long periods for this purpose.

An extension ladder is conveniently attached outside the body on the starboard side and a pikepole and a door opener on the portside. Two portable extinguishers ($CO_2$) are mounted forward inside the bus doors. Inside the cab there is an air-charging hose that is used to keep the truck tires up to pressure. There are also racks located on the top of the truck to store spare 5-gallon foam cans. Located in each truck should be a standard rescue kit.

The driver is responsible for the truck, the crew, and the readiness of both at all times. The crew assignment for the MB-1 crash truck is as follows: one driver, two turretmen, and two rescuemen.

When proceeding to the scene of a crash, the turretmen and the rescuemen ride in the pump engine compartment. The turretmen start the pump engine and engage the clutches while the truck is underway. As a safety precaution, turretmen will not man the turrets until the truck nears the crash.

While definite inspection and/or service routines of the MB-1 truck may be assigned

to a specific member of the crash fire department, it is desirable to ensure that each member of the crash crew is instructed in the operation and function of all components of the apparatus.

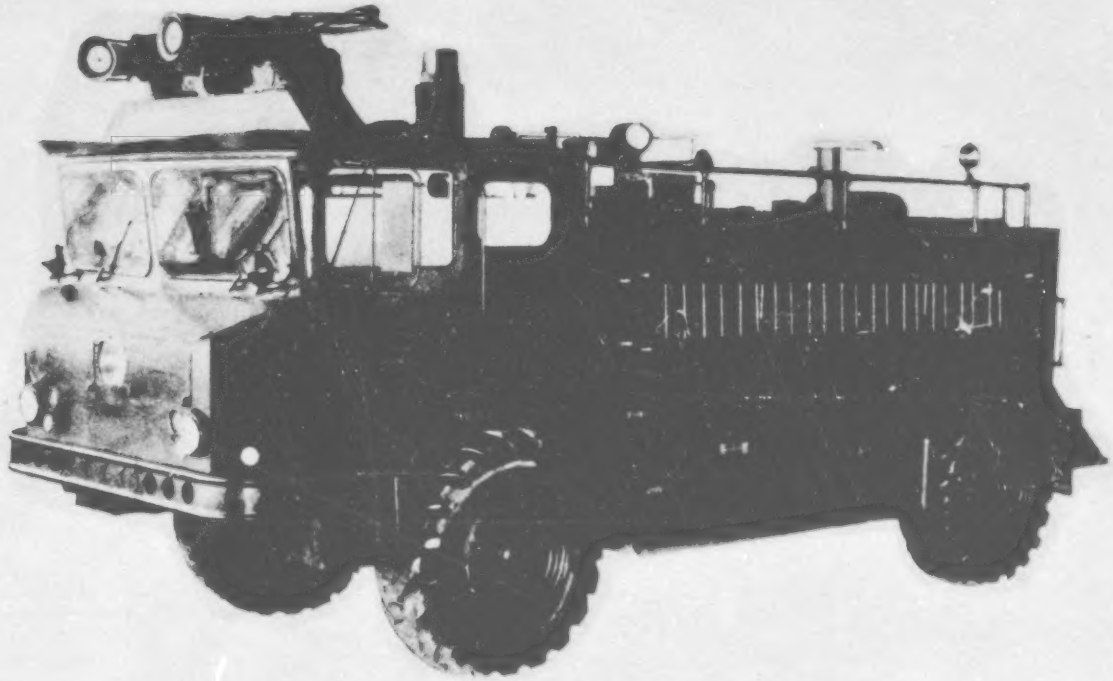
A rigid inspection and preventive line maintenance procedure has been established which will provide maximum vehicle efficiency, prolong the operating life, and reduce periods of deadline.

All major maintenance and repair for the MB-1 crash truck is accomplished by the transportation division of the station's public works department.

MB-1A Truck

The Yankee-Walters MB-1A is mounted on a 4 x 4 chassis, is powered by a 300-hp, multifuel engine (Marine) or a 318-hp gasoline engine (Navy), and is equipped with an automatic transmission. Gross weight is approximately 38,000 pounds. It can reach 50 mph in 32 seconds and attain a top speed of 65 mph. The feature of this truck is simplicity and ease of operation. It is equipped with a 6,000-gpm positive displacement rotary sliding vane type foam pump, powered by one engine. (See fig. 4-9.)

The purpose of the MB-1A truck is to extinguish fire on burning aircraft and to conduct rescue operations. The primary fire extinguishing agent used in the truck is foam. A foam-maker pump conbines water, foam concentrate, and air to produce a thick fire-smothering foam. The foam is discharged onto the aircraft through two turrets mounted on the vehicle cab roof. Two operators man the turrets through cab roof hatches by standing on platforms in the cab; each of the two operating positions provides a separate foam pump control. After the pump engine has been actuated from the cab, operation of the turrets is entirely in the hands of the turret operators. The turrets may be rotated to any desired angle, and a lever-operated control on each



200.32

Figure 4-9.—Aircraft crash firefighting and rescue vehicle MB-1A.

turret provides a discharge pattern that is variable from a straight stream of foam to a full spray. A secondary handline foam and water system is also provided, as well as a dry chemical dispensing system.

The two configurations of the MB-1A truck are designed to meet different operational requirements—the gasoline truck is for use in land-based operations where gasoline is readily available, and the multifuel truck for expeditionary operations in areas where standard grades of gasoline may not be obtainable, and where the truck may be required to ford sea water. Both trucks are capable of traversing any type of terrain that may be encountered, including mud, soft sand, and steep slopes.

The MB-1A truck is a 2-axle, 4-wheel drive, rear-engine truck, equipped with power steering, fully automatic transmission, and hydraulically actuated air brakes. The truck has a 5-man cab at the front with two access hatches to the roof to permit operation of the turrets. The major components of the turret foam-maker system are installed in the pump compartment adjacent to the cab. These components are accessible through a removable panel on the roadside of the truck. A pump vane inspection door is located on the panel.

The pump engine, mounted behind the pump, is accessible topside through a door. The 50-gallon-capacity fuel tank is located longitudinally under the pump compartment, refillable through a door. The foam tank (holding 130 gallons of foam concentrate) and the water tank holding 1,000 gallons of water) occupy the central portion of the truck body. These tanks are serviced by refill and drain facilities at the rear, roadside, and topside of the truck. Two handline foam and water systems are provided in separate compartments, one on either side of the truck.

A 150-pound dry chemical stationary unit equipped with a handline is mounted in a compartment on the curbside of the vehicle; adjacent to this system are racks containing three 30-pound portable dry chemical extinguishers. Firefighting tools, consisting of a combination hydrant and spanner wrench and a claw tool, are stowed in brackets in a tool compartment curbside. The rear-engine compartment containing the vehicle main engine is accessible by grating type steps and is protected by a flat-topped hood. Two 12-volt batteries and an auxiliary generator system are installed in the main engine compartment on top of the engine housing.

An auxiliary generator, whose engine draws fuel from the truck fuel supply, can charge the batteries and furnish power to operate the truck heating and sound systems in case of main engine failure. When the main engine is operating, the auxiliary generator is automatically cut off; but should the main engine fail, a switch in the cab can start the auxiliary generator motor.

An engine, either gasoline or multifuel, to correspond to the main engine since they both use fuel from the same tank, drives a foam-maker pump and proportioner to supply foam to the two top turrets only. The pump has a normal foam discharge capacity of 6,000 gallons per minute or 3,000 gallons per minute to each turret, and the proportioner controls the admittance of foam to the water to maintain 6-percent concentrate. The proportioner admits foam concentrate to the water in accordance with the rate of flow of the water; the mixture is mechanically mixed and agitated in the foam maker system; and air is drawn into the mixture to produce the foam of proper quality which is then fed via the lines to the turrets.

Foam can be dispersed through the two swivel-mounted turrets on the forward roof of the cab of the truck. Each turret has a handlebar control for pointing the turret, a hinged lever for adjusting the spray pattern, and a special locking device to prevent rotation of the turret when not in use. The instrument panel for the turret provides foam, flush, and off controls for each turret; gages that indicate the level of liquid in the water and foam concentrate tanks; and a tachometer that monitors the pump engine rpm.

There are two handline systems provided, one on each side of the truck. The hose reel of the handline system contains 100 feet of 1-inch hose which can be rewound electrically. A pistol grip type of shutoff valve has two nozzle attachments, one for disbursing foam (at a rate of 36 gallons per minute) and the other for water (at the rate of 60 gallons per minute). Both the foam and water nozzles adjust from a straight stream to a dispersed spray. The water and foam concentrate mixture comes from the pump, and the air enters the foam-maker attachment at the pistol grip end, creating the necessary turbulence to produce

the desired mixture. The air, under pressure, comes from the air brake system of the truck. The main rear-mounted engine of the truck drives the handline pump via a power takeoff and is controlled from the cab.

The foam-maker system for the turrets and the handline foam and water systems are both supplied by the 130-gallon foam tank and the 1,000-gallon water tank. The foam tank can be filled by four foam concentrate cans at one time or by pump-filling the tank from the side (which also acts as a foam tank drain). The water tank can be filled by two inlet pipes topside or by two inlet pipes at the rear of the truck. The water tank has an opening for inspection and cleaning. The tank can be drained through the rear inlet pipe or by a drain valve under the water tank. A single control gravity drain is provided for draining the turret and handline systems after firefighting operations.

Care must be exercised after each use of the turrets or handlines that the pumps and lines are thoroughly flushed out with clear water. This is to prevent the foam material from drying in the pump or lines and valves, which can cause breakdown of the system. Consult the appropriate maintenance manual for instructions on how to conduct the inspections of the systems.

A 150-pound stationary dry chemical system with a 100-foot handline is a part of the firefighting equipment on the truck. The system uses potassium bicarbonate to extinguish the fire, and nitrogen gas is used to propel the chemical to the fire. The nozzle of the handline is capable of discharging 90 percent of the 150 pounds of dry chemical powder in 25 to 30 seconds. The powder storage bin is filled from the top of the truck by means of a special funnel and sleeve device furnished with the truck.

Other firefighting equipment aboard the truck includes three portable dry chemical extinguishers, each with a capacity of 30 pounds, that are stored vertically on racks on the truck; an adjustable combination hydrant and spanner wrench; and a general purpose claw tool.

The truck is provided with a hot air heater that heats both the pump engine compartment and the cab; windshield wipers and washers that are air-actuated; a combination siren and speaker system; two adjustable spotlights; adjustable floodlights to illuminate the top working deck; a red rotating beacon on top of the cab; a 500-watt wide light on the front of the truck; and clearance, head, parking, stop and tail, directional, signal, dome, compartment, and instrument panel lights.

While definite inspection and/or service routines of the MB-1A truck may be assigned to a specific member of the crash fire department, it is desirable to insure that each member of the crash crew is instructed in the operation and function of all components of the apparatus.

A rigid inspection and preventive line maintenance procedure has been established which will provide maximum vehicle efficiency, prolong the operating time, and reduce the length of repair time required when breakdowns occur.

### MB-5 Trucks

The Navy older type MB-5 crash truck is a lightweight, high-performance vehicle mounted on a 4 x 4 chassis and powered by an 8-cylinder, rear-mounted, gasoline engine. This truck is designed to carry auxiliary extinguishing agents and equipment as well as foam and water. It has a capacity of 400 gallons of water and 30 gallons of foam concentrate. The foam-making components are the same as in the MB-1. A power takeoff drive arrangement is used on the turret foam system so the vehicle cannot move while pumping.

The features of this truck are a specially insulated body equipped with sliding doors; hose reel, equipped with an interchangeable foam and water spray nozzle; a bayonet piercing nozzle; two-way radius searchlights and floodlights for night operations; and a separate gasoline auxiliary power unit to recharge batteries. Standard equipment provides three 30-pound Purple-K-Powder extinguishers for aviation fuel fire and wheel and/or tire fires, and one 50-pound carbon dioxide extinguisher. (See fig. 4-10.)

The following firefighting tools are included:

Adjustable hydrant wrenches and Halligan door openers or Hayward claw tools. These tools are mounted in the cab.

Metal cutting saw. This saw is intended for aircraft forcible entry and rescue purposes and is mounted in a closed compartment forward of the right rear wheel. Power for saw

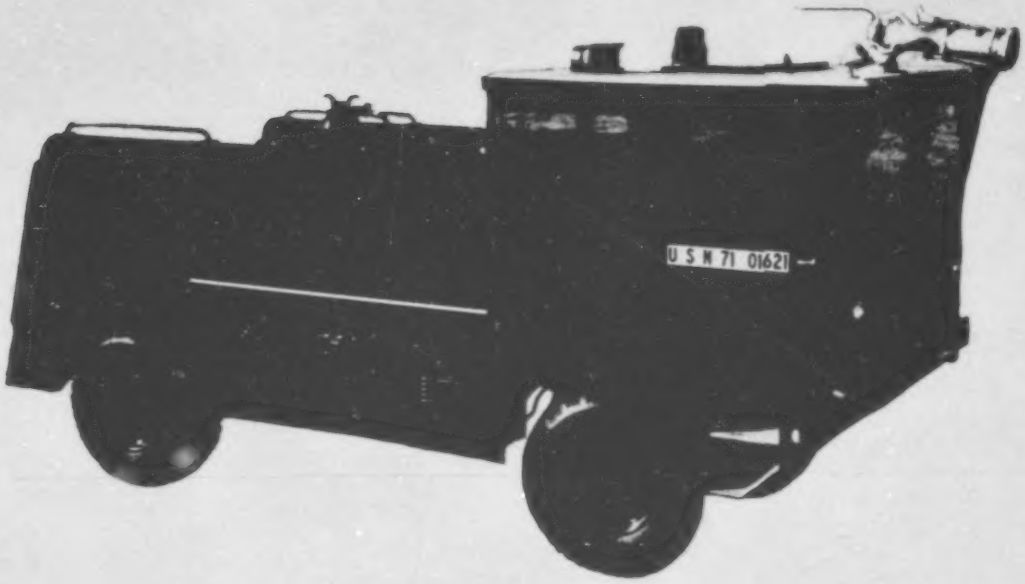



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Figure 4-10.—Aircraft crash firefighting and rescue vehicle (old type) MB-5.

operation is provided by a 230-volt, 180-hertz, 3-phase generator, belt-driven from a power takeoff on the transfer case.

A 50-foot live cable reel is provided and is mounted in the saw compartment.

The foam pump-turret is the main output of the truck. It is exactly the same as one of the foam systems on the older type MB-1 trucks except that it does not have an independent engine drive.

Because of the nature of the pump drive train, it is necessary to have the driver engage the power takeoff after the vehicle has been properly positioned and stopped at the fire scene. Once this is done the turret operator has complete control of the turret output until such time as it may be necessary for the vehicle to move.

The turret is mounted on the cab roof and is operated by standing on the center seat with the roof hatch open. The construction and manipulation of the turret are the same as for the old type MB-1. A separate pumping system handles the handline nozzle. A centrifugal pump driven from a power takeoff supplies foam solution or water to the nozzle. The driver engages the power takeoff and opens the pump suction valves to start the system. He must set the hand throttle or control the foot throttle to maintain proper pressure. The pump being of the centrifugal type allows the handline operator to open and shut his nozzle without concern to the pump speed.

The handline nozzle is stored [illegible] hose reel compartment. It consists of a shutoff valve and three interchangeable discharge devices. One is a variable pattern foam-making nozzle, the second is an adjustable water spray nozzle, and the third is a bayonet nozzle. All are fitted with a quick disconnect type joint to permit rapid change of attachments. The spray nozzle and bayonet nozzle are normally used with plain water. The valves used to set the system for water or foam solution must be operated from the driver's position in the vehicle cab. The bayonet nozzle is used to pierce the skin of the aircraft to cool the interior with a spray of water.

The water tank capacity is 400 gallons. It can be filled either through an opening on the

top deck or through a valve on the curbside of the truck.

The foam concentrate tank capacity is 34 gallons, but is only filled to a working capacity of 30 gallons. The truck is filled with foam from the top deck by removing the round tank top cover and pouring in the foam slowly so as to prevent excessive frothing. A transparent plastic tubing inside the cab serves as a sight level gage. It should be cleaned frequently for accurate reading.

Just as with the MB-1 and MB-1A, the MB-5 truck pumping systems must be thoroughly flushed with water whenever the system has pumped foam.

A newer type of crash rescue vehicle, the Oshkosh MB-5, operates as a self-contained unit and does not require any accessories or material other than those it carries to perform its normal function. Various compartments and mounting facilities are provided for the storage and transport of the necessary firefighting and rescue equipment. (See fig. 4-11.)

This truck is a four-wheel drive vehicle with a semiautomatic "power shift" transmission that provides four forward speeds, neutral, and reverse. Operator controls include power steering and power brakes to all four wheels. A normal complement of gages, instruments, and switches for the operation of all accessories is provided on the dashboard instrument panel.

The gross weight is 20,000 pounds, and the truck will carry 420 gallons of water maximum; recommended fill, 400 gallons. The agent concentrate tank capacity is 34 gallons; recommended fill, 30 gallons. The agent concentrate and water tank is a fiberglass, compartmented tank located under the top deck of the vehicle, between the personnel cab and the engine. The tank is of one-piece construction with a removable cover. The foam tank is a separate compartment molded into the front roadside (port) of the water tank. The water tank is provided with molded-in baffles to minimize "sloshing" and the resultant rapid weight transfer. The tank cover is fitted with two separate hatches, or filling covers, one for water and one for agent concentrate.

The foam and water system is actually two separate systems—the turret supply and the handline supply. Although both systems are supplied by a common source, each has its own pump. Both systems will pump water only or an agent concentrate and water mixture. All controls are located in the personnel cab and are readily accessible to the driver and/or the turret operator. Unlike the older MB-5 trucks, the newer Oshkosh trucks may operate the turret and handline systems while the truck is moving.

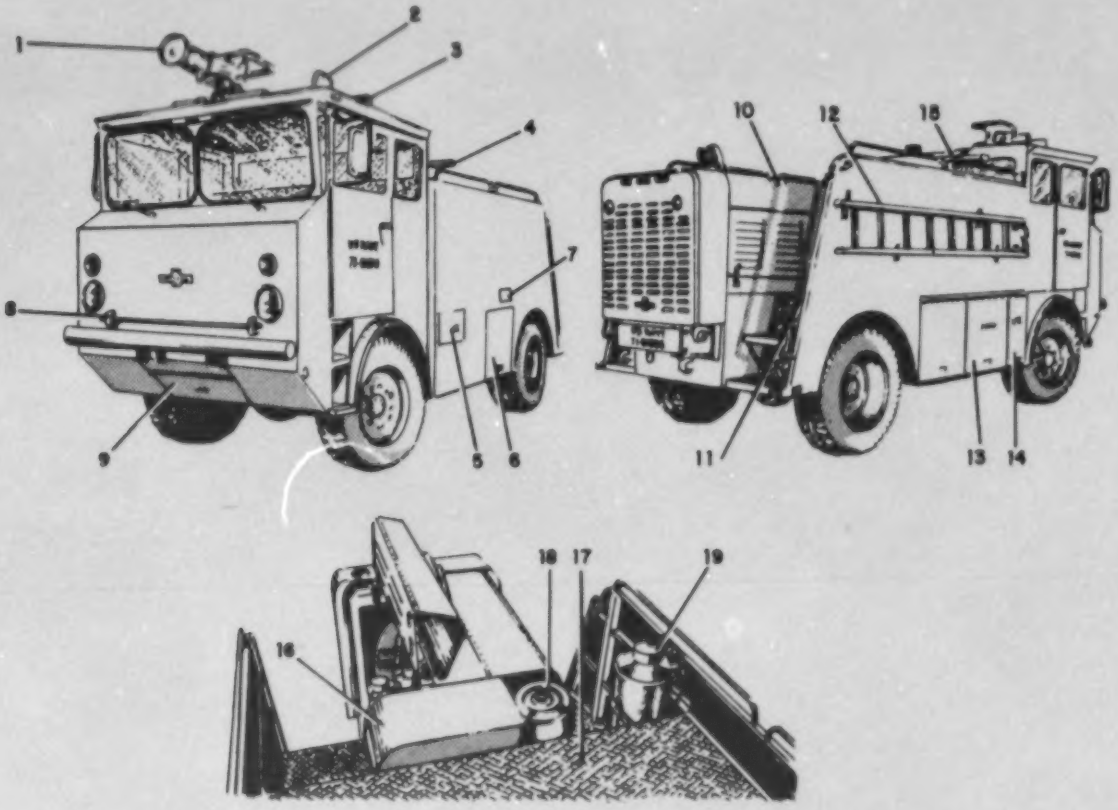
NOTE: When the truck has reached the side of the fire, the operator must place the pumping governor switch in the "ON" position. This will immediately limit engine speed to 1,300 to 1,400 rpm. Due to an electrical interlock, the turret valves and the front handline valves cannot be opened until the pumping governor switch is "ON." Operation of the truck must be restricted to the use of first, second, and reverse gears only when the governor switch in "ON." The turret pump is a rotary vane type capable of 3,000 gpm, the same capacity as that of the turret.

The dry chemical system (P-K-P) consists of a 150-pound capacity canister and a nitrogen cylinder that is used to propel the P-K-P. The nitrogen cylinder and dry chemical canister are accessible from the roadside workdeck, and the system discharge is through a hose reel handline. The truck also carries three dry chemical (P-K-P) fire extinguishers of the portable type. They are mounted in a storage compartment on the curbside (starboard) of the vehicle.

Runway Foamer/Nurse Truck

The firefighting-agent carrying capacity of aircraft firefighting and rescue vehicles has always been severely limited because of the need for vehicle performance both in acceleration and off-highway operation. One common attempt at solving this problem has been the use of auxiliary trucks which have greater capacities and which serve to replenish the faster, first-response vehicles at the scene of a fire. The nature of this operation has led to the popular name of "nurse" truck.

Runway foaming vehicles and auxiliary tank vehicles have two important features in common: the carrying of copious amounts of water and foam concentrate and a means of pumping both at high flow rates. These features make




1. Foam turret.
2. Spotlight.
3. Emergency beacon.
4. Foam tank vent.
5. Foam tank fill and drain valves and fuel filler access door.
6. Dry chemical system handline compartment door.
7. Nitrogen cylinder valve compartment.
8. Front handline bayonet applicator.
9. Front handline compartment door.
10. Main engine compartment.
11. Battery compartment.
12. Ladder hooks.
13. Fire extinguisher compartment.
14. Hydrant fill, water tank drain valve and tool compartment.
15. Water tank vent.
16. Auxiliary generator compartment.
17. Work deck.
18. Main engine air cleaner.
19. Dry chemical tank.

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Figure 4-11.—Oshkosh MB-5 firefighting and rescue truck.

Table 4-2.—Average aircraft slide distances on foam

| AIRCRAFT[1] | NOSE GEAR UP | ALL GEAR UP | BOTH MAIN GEAR UP & NOSE GEAR DOWN |
|---|---|---|---|
| Light single-engine propeller aircraft A-1, T-28 | 1500 ft | 1500 ft | 1500 ft |
| Light twin-engine propeller aircraft S-2 | 2500 ft | 1700 ft[2] | 1700 ft |
| Heavy Twin-engine propeller aircraft C-117, P-2 | 3000 ft | 2000 ft | 2000 ft |
| Four-engine propeller aircraft C-118/121/124/P-3 | 3000 ft | 2500 ft | 2500 ft |
| Single and twin-engine jet aircraft F-8/9/4, A-3/4/5, C-2/E-2, A-6, A-7 | 4500 ft[3] | 3500 ft[4] | 3500 ft[5] |
| Heavy three and four jet engine aircraft C-135, DC-8, P-3, C-130 & | 4500 ft | 4000 ft | 4000 ft |

[1] This is not a complete aircraft list. Models are chosen as representative examples of aircraft, size, weight, and configuration. See NATOPS for details. These distances are averages rounded off to larger whole numbers.

[2] Conventional-geared C-45 similar.

[3] F-9 and A-4 only 3000 ft.

[4] A-4 only.

[5] Not applicable to A-4, see NATOPS.

it possible and desirable to combine them both into one vehicle as both functions are not required simultaneously.

Usually, a refueler truck is converted to combine the functions of foaming runways and serving as a "nurse" truck to resupply water and foam concentrate to aircraft firefighting vehicles.

The vehicle should be capable of carrying at least 3,000 gallons of water and 200 gallons of foam concentrate. This is equivalent to three loads of the largest primary vehicle—the MB—and can provide the MB-1 with 8 minutes of continuous foam application at a rate of 6,000 gpm or a total of 48,000 gallons of expansion 12 foam. Of course, it is necessary that the nurse truck be capable of transferring both liquids in excess of the output rate of the MB-1, which is 530-gpm water and 30-gpm foam concentrate. Allowing some time for delayed arrival and making the necessary hose connections, the nurse vehicle should have a minimum output of 600 gpm of water at 15 psi and 45 gpm of foam concentrate.

NOTE: Light water foam is not satisfactory for runway foaming; protein type foam must be used for runway foaming. See Table 4-2 for average slide distances on foam.

A minimum pumping rate of 600 gpm at 100 psi will also expedite runway foaming operations, as rate of area coverage depends directly on the rate of water discharge and

foam production. On the basis of 0.1 gallon of water per square foot required to cover the runway surface adequately, a total of 30,000 square feet can be covered by one load of 3,000 gallons of water in 5 minutes.

Time and circumstances permitting, an airfield runway may be foamed in preparation for the landing of an aircraft experiencing landing gear malfunction. The intent is to minimize the fire hazard by the suppression of friction-generated metal sparks.

Information concerning an anticipated foaming is communicated via the crash circuit by the operations duty officer or the control tower immediately to provide the crash crew with maximum time possible.

The operations duty officer, after conferring with the crash captain, determines the feasibility of providing the requested runway foam based on the availability of crash equipment, prevailing weather conditions, and the time required for its application. He then notifies the crash captain immediately when runway foam is to be used and gives the following information:

1. Time aircraft can remain airborne.
2. Type. Foam pattern #1—all gear up, indicating belly landing. Foam pattern #2—foam at arresting gear, indication partial gear down. Give particulars on which gear is down so swerve direction can be estimated.
3. Designate runway to be foamed.

Plans for foaming a runway should never include use of the primary aircraft firefighting and rescue vehicles. Full firefighting capabilities for use after the aircraft has touched down must not be compromised in any way. The flight plans of an aircraft under emergency conditions are usually subject to sudden change and this may lead to being caught with empty or partially filled vehicles should the plane come in ahead of schedule. Therefore, only vehicles over and above the normal required complement should be used for runway foaming.

During foaming operations, continuous radio contact should be maintained between the foaming crew and the aircraft. A change in the pilot's status may cause him to come in sooner than expected, or it might be necessary to break off the foaming to reload the trucks. Orbiting the aircraft to achieve a low fuel state will materially lower the fire hazard.

Truck-Mounted TAU

This unit combines the quick flame knockdown capability of P-K-P with the vapor-securing and blanketing ability of light water, providing a rapid and lasting flame extinguishment. Therefore, this unit provides a means of effecting rapid rescue of personnel from burning aircraft.

The TAU is a self-contained, skid-mounted, fire-extinguishing system, consisting of two 28-inch-diameter aluminum spherical tanks, one containing 400 pounds of P-K-P and the other containing 48.5 gallons of light water solution. The contents of the two spherical tanks are discharged by pressure from two cylinders of high-pressure nitrogen. A 100-foot dual hose line supplies the two fire-extinguishing agents to the single firefighter's dual nozzle holder. Pistol grip trigger valves control the flow of each extinguishing agent. These units are designed for mounting on crash-rescue trucks (Dodge Power Wagon, 4 x 4) and as such will replace the Navy airlift type, 400-pound dry chemical extinguisher, mounted thereon. (See fig. 4-12.)

This light water-dry chemical fire extinguisher is an efficient extinguisher of class B flammable fuel fires and mixed class A and B fires. The 800 pounds of extinguishing agents contained in the TAU will extinguish 2,500 square feet of JP-4 fuel. The light water foam used singly provides an excellent vapor-proof coating for unignited flammable fuel spills. The TAU will fully extinguish and fireproof a circular fire area, containing obstacles, of about 50 feet in diameter. A rescue path may be made into larger fires with the equipment, and personnel may be rescued in complete safety from fuel reflash although fires may exist at the sides of the path. This unit, mounted on the required crash-rescue truck, can be used on runway and standby alerts where an MB-5 is ordinarily used.

The Purple-K-Powder dry chemical used provides for quick knockout of fires. The application of the light water to extinguished fuel prevents backflash of fire. Operation of

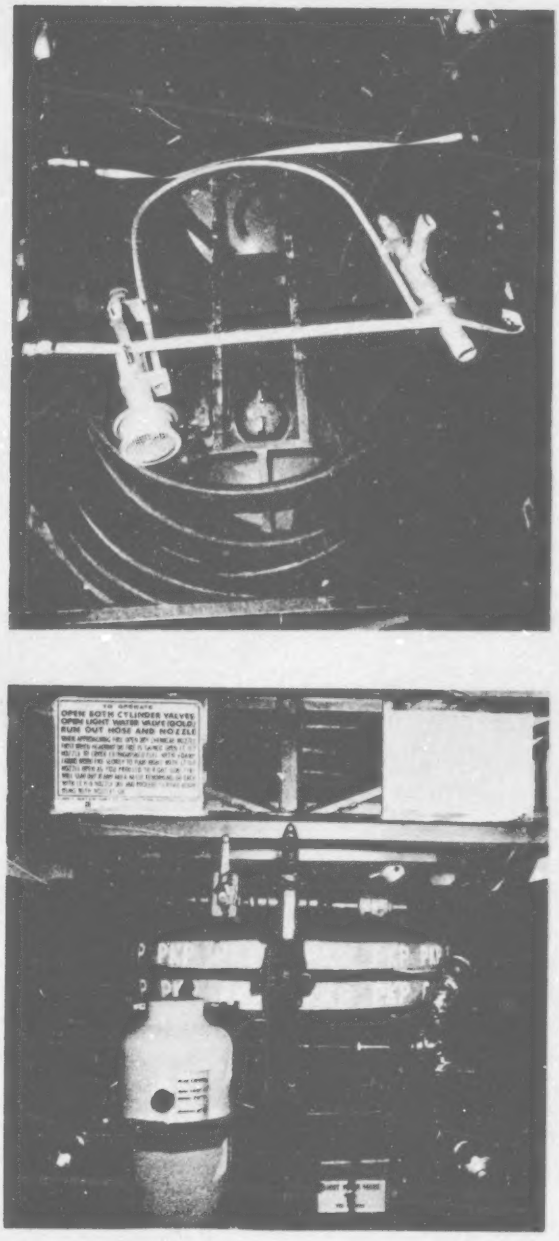

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Figure 4-12. — Truck-mounted twinned agent unit (TAU).

the fire extinguisher must be performed smoothly and skillfully since available continuous discharge time is 55 seconds for the light water and 80 seconds for the dry chemical.

The twinned light water-dry chemical fire extinguisher is equipped with twinned hose and trigger-operated twinned nozzles, each having its own shutoff valves, and may be operated independently or simultaneously. (See fig. 4-13.)

In the event of a fire, position the extinguisher to within approximately 50 feet from the fire and upwind if possible. Open both nitrogen cylinder valves. Pull the ring pin and open the light water valve, then release the hose and nozzle holddown and pull the twin hose and nozzle assembly from the hose basket, allowing the hose to twist freely. Hand the nozzle to the firefighter.

Approach the fire from upwind; open the dry chemical nozzle first. Direct the dry chemical at the base of the flames covering the entire width of the fire or rescue path at first with a side-to-side sweeping motion. When headway is gained on the fire, open the light water nozzle to cover extinguished fuel with foamy liquid. Work the fire slowly to your right with both nozzles open as you proceed to the right side. Fire will stay out. If any area needs reworking, go back with the light water nozzle off and proceed to the right, again using both nozzles on. After light water has been used, rapid side-to-side sweeping will not be necessary.

After the fire has been extinguished or a rescue path has been secured, close nozzles and standby to assure no additional fire occurs and to protect the rescue operators.

Purple-K-Powder should not be directed into the intake or used in the accessory section of jet engines until other attempts have failed to extinguish the fire. The fine grain powder will penetrate minute crevices and leave a residue which, if ingested into a jet engine, will penalize engine performance and restrict internal cooling air passages thereby requiring disassembly of the engine to remove deposits. Purple-K-Powder that has penetrated small crevices in and around the accessory section and has been exposed to moisture is very difficult to remove completely and eventually will cause corrosion. Therefore, Purple-K-Powder should not be used on internal and accessory section jet engine fires and electrical

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Figure 4-13.—Operator holding twinned nozzle assembly.

equipment fires until it is apparent that carbon dioxide extinguishers will not extinguish the fire.

## RESCUE EQUIPMENT AND CLOTHING

All of the Navy crash trucks have some emergency entry tools as part of the basic equipment furnished with the truck. These include ladders, axes, etc. Other equipment carried consists of a metal-cutting power saw, a Halligan tool, and a crash-rescue toolkit. The station fire chief must see that this equipment is carried on each of the crash trucks assigned to the firefighting crew. Also, one of the vehicles should be designated as a rescue vehicle. It will normally be the first vehicle on the scene, and it will also have these tools, along with some specialized rescue equipment.

The procedures for using the forcible entry tools are covered later in this chapter.

To ensure that the equipment is always complete and readily available, the fire chief makes frequent and careful inspections. He must arrange for intensive, continuous training to assure that personnel in all platoons are fully qualified to handle this equipment. This equipment must be restricted to crash-rescue use only.

Aircraft crash/rescue protective clothing is a prime safety consideration for personnel engaged in firefighting and/or rescue operations. Metalized protective clothing offers a means of providing protection to the firefighters because of its high percent of reflectance to radiant heat. Aluminized proximity fabrics have been adopted for use in the Navy crash/rescue program. It is important to point out that these garments are not classified as entry suits, but are known as proximity clothing. As previously stated, the aluminized proximity suit gives the wearer good protection against radiant heat. However, aluminum is a good conductor of heat, and therefore will not give much protection against direct flame contact.

The heat reflective ability of aluminized clothing items is reduced when they are stained or otherwise dirty. Additionally, the garments will develop hotspots where the metal flakes off or the fabric cracks or tears. For the above reasons, and to reduce replacement costs, it is imperative that each supervisor insures that all personnel in his charge are completely familiar with the following care and maintenance instructions.

1. Storage should be on hangers, or neatly folded. If folded, the folds should be loose. Sharp folds or creases will crack the metalized fabric. Do not sit on or place objects on a folded garment.
2. Dirt and soot should be sponged off with mild soap and water, and the aluminum surface dried with a clean soft cloth. Rub GENTLY, so as not to remove the aluminum impregnating the fabric.
3. Grease stains may be removed by the use of drycleaning solvents, isopropanol or perchloroethylene, instead of mild soap. Again, rub carefully. If you rub hard and remove any of the aluminum, the garment will have a hotspot.
4. Foam may be removed by sponging clean with mild soap and water. Hang to dry in the open, or in a place with good circulation. It is realized that during firefighting operations it is not always possible to prevent foam from getting onto protective clothing; however, it is pointed out that aluminized protective clothing which has been covered or spotted with foam will have less heat reflection than the suit normally provides.
5. Abrasive, harsh, or corrosive chemicals will react with the aluminum surface and etch the metal and, therefore, should not be used for any reason. Clean the clothing as stated above with mild soap and water and wipe dry; allow to dry at room temperature.
6. Garments should be replaced when the metal wears off or when the fabric cracks or tears. Spraying worn clothing with aluminum serves no useful purpose and is dangerous practice.
7. When wearing aluminized protective clothing, never sit, lean, or lie down as these actions subject the garment to unnecessary wear and stress.

# SHIPBOARD (FLIGHT DECK)

## CRASH SALVAGE CREW/TEAM

The crash salvage team's functions are to effect rescue of personnel from crashed and/or

burning aircraft on the flight deck, administer "emergency" first aid, fight fires on the flight deck, clear away wreckage, and make emergency repairs to the flight deck and associated equipment. The Aircraft Crash Salvage Officer is in direct charge of the crew under the supervision of the Flight Deck Officer (FDO) and the Air Officer (AO).

The crash salvage crew should consist of experienced personnel highly trained in flight deck firefighting, aircrew rescue, and flight deck repairs. The following is a suggested organization for use during normal flight operations. During limited flight operations, such as helicopter launch/recover, the basic organization and procedures may be modified by local directives.

1. Crash and Salvage Officer — Overall direction and supervision of assigned personnel.
2. Crash/Salvage Chief — Assistant to the Crash/Salvage Officer.
3. Crash/Salvage Petty Officer — A first class petty officer who assists the Crash/Salvage Chief in the direction and placement of firefighting personnel and equipment should a crash occur.
4. Salvage Petty Officer — Supervises and directs men and equipment and ensures immediate availability of all required aircraft salvage and removal tools and equipment. The Salvage Petty Officer normally has one assistant.
5. Equipment operators for the crash crane and crash forklift.
6. Minimum of nine firefighters and three rescuemen.

Ideally, each member of the crash/salvage team should be trained and qualified to perform the functions of every other member within the unit. During all launches and recoveries, rescuemen are stationed in the island area, on the alert to move anywhere on the flight deck. They are to be fully clothed in the firefighter's aluminized protective coat and pants and asbestos or aluminized gloves and boots. An aluminized helmet is carried to be donned when needed. The rescuemen should also carry a rescue knife for cutting seat restraint and parachute harnesses. Firefighters stand by fog foam stations in the event of emergencies, and provide KNOW HOW in manning the hose lines on fog foam and salt water stations. The crash/salvage team maintains all crash and firefighting equipment assigned to the division. In addition, they comprise the nucleus of the firefighting crew on the flight deck. The crash/salvage team's detailed functions are as follows:

1. Exercise all operating and maintenance safety precautions for firefighting equipment.
2. Exercise all damage control procedures for the flight deck area. Keep all crash and rescue equipment in a state of constant readiness.
3. Assist in on/off loading aircraft.
4. Assist the divisional damage control petty officer.
5. Have custody of and maintain all divisional equipment which is used during flight operations.
6. Have custody of, maintain, and issue all aircraft tiedown chains to squadron personnel on subcustody.
7. Assist aviation fuel crews with washdown of fuel spills.
8. Assist duty support equipment mechanic with crash crane and forklift checklist.
9. Man fire extinguishers during aircraft turnups and starts.
10. Man two aluminized rescue suits during flight quarters.
11. Man two starboard HCFF (high capacity fog foam) and two salt water stations during flight operations.
12. During recovery operations, provide towbars, chocks, and other equipment necessary for removal of aircraft flameout in the arresting gear area, brake failure, flat tire, etc.
13. Man crash crane and crash forklift during recovery operations.
14. Act as safety observers during all phases of flight operations.
15. Provide instructors for indoctrination of new personnel and/or embarked squadron personnel in shipboard firefighting equipment operation and application.
16. Assist the hangar deck crew with collapsed landing gear drills or actual emergencies, such as aircraft falling off jacks, etc.

## EQUIPMENT CRANES

Mobile cranes (NS-50 & 60) previously discussed in chapter 2 of this Rate Training Manual are provided on most all aircraft carriers in the fleet. These cranes are capable of lifting and "walking off" with any carrier aircraft; however, the lifting capacities of these cranes are 50,000 and 60,000 pounds,

respectively. Therefore, some of the larger type aircraft will have to be defueled prior to lifting (i.e., A5-J, A-3A/B, C-2A). They are an invaluable piece of equipment and should be maintained and operated accordingly.

FORKLIFTS

Crash forklifts used aboard carriers for the purpose of aircraft salvage should be in the minimum lifting class of 15,000 pounds or better and be powered by a diesel engine. The easy maneuverability of the forklift makes it most useful when it is necessary to speedily lift only one portion or side of an aircraft at a time. The padded lifting arm can be inserted under the wing, tail surfaces, or fuselage when necessary to lift an inverted aircraft for rescue purposes. Care should be taken to place the lift arm under a section of the aircraft that will sustain the weight without damage. It is well to remember that the use of the longer lift arm (6 to 8 feet) reduces the weight the forklift can safely lift without the possibility of the forklift tipping over. Due to the tremendous weight capability and stresses occurring in an emergency situation, it is recommended that solid tires be obtained for all forklifts used for crash/rescue operations.

Dollies

Truck dollies (crash) are provided on all carriers for the moving of heavy aircraft components and to serve as aids in moving crashed aircraft. This is a heavy-duty, low-bed dolly of welded steel construction with a hard fiber top surface and four swivel shock absorbing caster type wheels with nonsparking tread. Pipe type rails on all four sides of the dolly provide handholds and attachments for tiedowns. This dolly is designed to support a load up to 12,000 pounds.

These dollies can be modified in many different ways to serve specific purposes. One modification may be a steel structure to form a higher platform for use under a wing or nose section. Also, a heavy steel socket, large enough to insert a landing gear strut with the wheel broken off, is sometimes welded to the top of the dolly. Any modification to the dolly must be sufficiently strong to safely handle the load that will be imposed upon it.

Slings

Aircraft hoisting slings should be used with extreme care when lifting an aircraft in other than the normal three-point attitude relative to the flight deck. Loads on the hoisting sling fittings will be increased if a departure is made from this attitude. Instances of failure have been reported in which attempts were made to raise crashed aircraft which had become lodged in abnormal positions. In such cases it is considered safer to improvise a sling than use the aircraft's usual hoisting sling. Improvised slings should be safeguarded with heavy preventer lines. Improvised slings may be attached to such members as the main landing gear, crankshaft, catapult hooks, or by lines encircling the fuselage or wings at points of maximum strength, such as bulkheads and ribs. Provisions to prevent chafing of surfaces must be provided if salvage operations are intended. Reinforced canvas straps with hook-on provisions should be available in the crash locker for this purpose.

NOTE: When using nylon webbing for makeshift slings, at least two layers of webbing should be used.

Shipboard Twinned
Agent Unit (SBTAU)

In the event of a fire on the flight deck, the first and immediate response will be made by crews manning the SBTAU. The skid-mounted twinned agent unit fire extinguisher is used in applying a "light water" firefighting agent in conjunction with a dry chemical firefighting agent for purposes of rapidly extinguishing fires and preventing reignition of flammable hydrocarbon fuels. It is designed to permit it to be mounted within a compartment on the rear of the MD-3 tow tractor. It can be used in the corrosive salt environment on the flight deck or hangar deck aboard aircraft carriers. The light water concentrate is premixed with fresh water and is contained in an 80-gallon stainless steel cylindrical tank. The mixture is expelled with nitrogen gas through one-half of the twinned handline and nozzle. The "Purple-K" dry chemical agent is contained in an invertible, spherical, steel tank and is expelled with nitrogen gas through the other half of the twinned handline and nozzle. The system allows use of light water or Purple-K separately or both simultaneously.

COMPONENTS — ARRANGEMENT AND FUNCTION. — The major components which make up this fire extinguisher (SBTAU-2) are described below.

1. Dry Chemical Container — A spherical shaped steel tank is used to contain the 200 pounds of Purple-K agent. The container is constructed in accordance with the latest ASME Unfired Pressure Vessel Codes for a maximum working pressure of 230 psig and is so stamped. Nitrogen gas enters the container through a 1-inch swivel joint and the gas/Purple-K mixture is discharged through a 1 1/2-inch swivel. These swivels are located on opposite ends of axis of rotation.

2. Light Water Container — An 80-gallon capacity cylindrical stainless steel vessel contains the light water agent. This pressure vessel is also constructed in accordance with the latest ASME Unfired Pressure Vessel Codes for a maximum working pressure of 230 psig and is so stamped. The nitrogen enters the container at the top, and light water is expelled from the bottom. The tank is equipped with a liquid level gage for refilling purposes. NOTE: The bleed valve should be opened on top of the light water tank before unscrewing the liquid level gage.

3. Container Caps — Each container is equipped with a 4-inch-diameter fill opening and screw type self-venting pressure cap. The cap is constructed of brass and is equipped with a neoprene gasket for sealing purposes.

4. Nitrogen Cylinder — One ICC-3AA-2400, shatterproof, 400-cubic foot capacity gas cylinder is filled with nitrogen gas to a pressure of 2,400 psig at 70° F. The cylinder is equipped with a lever-operated valve and integral pressure gage. This pressure gage provides visual pressure reading of the gas pressure at all times.

5. Pressure Regulator — One single stage pressure reducing regulator is used to reduce the nitrogen pressure from the cylinder to 230 psig, the Purple-K and light water containers' operating pressures. This one regulator supplies both containers.

6. Bleed Valves — Two bleed valves are provided, one on the light water tank and one on the P-K-P container. Both valves are quarter-turn type ball valves and have to be manually opened and closed.

7. Pressure Relief Valves — Three pressure relief valves are provided, one at the inlet to each container and one on the pressure regulator. All three are spring-operated type and are set at 250 psig.

8. Check Valves — Two check valves are provided, one at the inlet to each container. They prevent the backflow of agent into the nitrogen gas portion of the system. A swing check valve is used on the dry chemical container, and a spring-loaded disc type is used on the light water tank.

9. Discharge Hoses — A twinned type line, 100 feet long, is used to discharge the two firefighting agents. It is constructed of two neoprene-lined and neoprene-covered hoses held together with a polyester outer jacket. The dry chemical hose is 3/4-inch in diameter while the light water hose is 1-inch in diameter. The neoprene hoses are equipped with brass, male and female, expansion couplings. The threads are 3/4-inch NPT and 1-inch NPT, respectively. The hose is coiled in a storage compartment on the rear of the extinguisher. NOTE: It is much easier to remove the hose from the hose compartment before charging it with agents.

10. Nozzles — A twinned nozzle is used on the twinned hose to expel the two agents. Each nozzle is equipped with a pistol grip handle and a trigger-operated shutoff valve. The two nozzles are fastened together approximately 2 inches apart to make up the twinned assembly. The dry chemical nozzle is equipped with a Fire Boss Lo-Re-Action discharge tip. It is rated at 4 pounds of Purple-K per second. The light water nozzle is equipped with an aspiration tip which is directed outward from the parallel planes of the nozzle handle at an angle of 22 1/2°. It is rated at 50 gpm of light water solution.

11. Pressure Gages — Two gages are provided; one for each container. Each gage shows the pressure in its respective tank while the system is operating. Both gages indicate "zero" when the system is in the "ready" condition.

12. Temperature Relief Valve — The light water tank is equipped with a temperature relief valve and actuates at a temperature of 212° F. This is a fusible plug-type valve. When the relieving temperature is reached, the plug material melts allowing pressure to escape. This valve is not reusable and must be replaced after it has relieved.

13. Dry Chemical Agent—The SBTAU-2 is delivered with 200 pounds of Purple-K agent in accordance with Military Specification MIL-F-22287A (WEP).

14. Light Water Agent—Five gallons of 6 percent MIL-F-23905(B) light water concentrate is shipped with each SBTAU-2. The concentrate must be mixed with fresh water at the rate of 5 gallons of concentrate to 75 gallons of fresh water. This may be mixed right in the light water container. However, precautions should be taken to prevent excessive foaming or frothing of the mixture during mixing. NOTE: See filling instructions to properly mix the agent and water.

OPERATION.—When the lever valve on the nitrogen cylinder is pulled to the open position, high-pressure gas, 2,400 psig at 70° F, flows to the regulator. The pressure is reduced to 230 psig by the regulator. The 230-psig gas flows into the dry chemical container, and into the light water tank. A pressure gage at the inlet of each tank indicates the operating pressure of the tank.

As the gas flows into the light water tank, the light water is forced out the discharge. No gas will be discharged from the light water tank until all of the light water solution is exhausted.

The gas flowing into the dry chemical container aerates and fluidizes the Purple-K agent. As the gas leaves the container, the Purple-K agent is carried along suspended in the gas stream by the velocity of the moving gas. Therefore, a mixture of gas and Purple-K is discharged through the handline and nozzle. Gas will continue to flow after the Purple-K is exhausted since the 400-cubic-foot nitrogen cylinder has a capacity greater than that required to discharge all the Purple-K and light water.

This system is protected from excessive pressures by three pressure relief valves, one at each of the agent tanks, and one on the pressure regulator. Each relief valve is set at 250 psig. An additional relief valve is provided on the light water tank. It is a temperature relief valve set to relieve when a temperature of 212° F is reached.

OPERATING AND MAINTENANCE INSTRUCTIONS.—The following instructions should be followed to operate the SBTAU-2 fire extinguisher and to return it to service after use.

TO OPERATE:

1. Open the nitrogen cylinder valve by pulling the valve handle forward.

2. Open the hose line valves located at the left of the hose box. NOTE: These valves can be left open at all times to expedite placing unit into operation.

3. Uncoil hose to desired length. NOTE: The hose is much easier to uncoil if it is done prior to charging.

4. When approaching the fire from the windward side, open dry chemical nozzle, applying the agent to the base of the fire using a side-to-side motion. After headway is gained, open the light water nozzle and apply the agent in a side-to-side motion to cover extinguished fuel with the foam liquid. Work fire slowly from right to left, applying Purple-K and light water, extinguishing the fire in and around the aircraft fuselage for rapid rescue of personnel. Fire will stay out. NOTE: Do not apply Purple-K for too long a period because you cannot see where to apply light water. If any area needs reworking, back up and proceed with the above technique until the fire is extinguished.

AFTER USE:

1. Close nitrogen cylinder valve.
2. Open both tank vent valves.
3. Bleed residual pressure of dry chemical sphere through handline. (This clears handline of remaining powder.)
4. With pressure dissipated, loosen cap with the wrench provided on unit and slowly remove the cap from each container.
5. Refill dry chemical sphere to top. Replace cap and tighten with wrench.

6. Refill light water container as indicated on Refill Chart on cover, or for complete charge:

Fill light water tank with approximately 50 gallons of fresh water with a garden hose, then pour 5 gallons of light water concentrate in tank using funnel provided, replace garden hose on bottom of tank and fill slowly within 1 inch of cap opening. NOTE: It is very important to use this method of filling the light water tank to insure proper mixing of the solution. Replace cap and tighten with wrench.

7. Replace nitrogen cylinder if gage reads below 1,700 psig.

8. Close vent valves.

MAINTENANCE

1. Check nitrogen cylinder pressure daily. Replace if below 1,700 psig.

2. Check twin agent nozzle shutoffs to see that they operate freely. Be sure that nozzle shutoff is in the closed position.

3. Protect against freezing. If temperature is 32° F or lower, unit will have to be kept in warm spaces on hangar deck, and exchanged to flight deck periodically to maintain it operational.

## TAU-3

The TAU-3, at the time of this writing, is in the final stages of evaluation and will eventually replace the TAU-2 and the MB-5 crash fire and rescue truck currently being used on the flight deck of carriers today. Because of its payload, size, maneuverability, and ease of operations, the TAU-3 is infinitely better in all phases of aircraft firefighting on carrier flight and hangar deck.

The self-propelled twin agent firefighting vehicle, model TAU-3, is designed for extinguishing military aircraft fires onboard CV/CVAs. Its primary purpose is to provide a quick response reaction to aircraft fires and commence extinguishment until such time that the ship's force can actively engage in damage control.

A two-man crew operates the light water (AFFF solution) system and dry chemical (P-K-P) system as required to control or extinguish aircraft fires and to quickly establish an access path to trapped personnel.

The TAU-3 is a diesel-powered four-wheel vehicle. It is 40 inches high, 65 inches wide, and 175 inches long. The gross weight of the TAU-3, fully loaded, is approximately 12,500 pounds, unloaded, 8,800 pounds. It has a hydraulic drive system powering the rear wheels. It has front wheel power steering, four-wheel self-adjusting hydraulic brakes, and a rear wheel parking brake system. On-board tanks contain 400 gallons of light water (AFFF solution) and 200 pounds of dry chemical (P-K-P). The dry chemical is extremely effective in flame extinguishment, but provides no security against flame reignition. The light water solution develops an oriented surface active film which spreads over the fuel-air interface. This film is impervious to the penetration of fuel vapors and, thereby, minimizes fuel reignition.

To provide the necessary expellent energy to utilize the dry chemical, a 400-cu. ft capacity nitrogen cylinder is incorporated in the system. When the firefighting system is energized, the nitrogen enters the dry chemical tank, fluidizing and pressurizing the dry chemical which is dispensed via a dry chemical nozzle at the end of an 80-foot hand line. The nozzle is one of an attached pair, the other being used for light water solution. The hose is mounted on a reel at the forward end of the vehicle.

The driver is situated in the forward left quarter of the vehicle and operates the turret, the bumper nozzles, and/or the hand line (AFFF-P-K-P solutions). The crewman stands (squats) on the folding platform that is located on the back of the vehicle. He is used for either the AFFF hand line (located on the right side of the vehicle), the front hand line, or for rescue operations. A third person can be used to operate the hand line(s), and/or for rescue operations.

Upon discovery of a fire, the vehicle is manned and driven to the fire area. A push-button on the dashboard of the vehicle is depressed, charging the dry chemical tank with high-pressure nitrogen. As the vehicle approaches the fire, the fixed forward nozzle is activated. The light water stream is directed through the nozzle by the driver/operator. Both the driver and the crewman are protected by armor shield which can be raised when the danger of an explosion exists.

The crewman can also operate the turret nozzle by means of a remote control box, and can remove the remote control box from the rack and move up to 100 feet away from the vehicle for protection and better visibility. The twin hose may be unreeled and, with the forward nozzle shutoff, the 80-foot double hose may be used to attack the fire. Actuation of the parking brake will automatically shut off the fixed turret nozzle.

The dry chemical average discharge rate is about 5 pounds per second. Maximum total light water discharge rate is 160 gallons per minute. The vehicle can be connected to the ship's supply to obtain continuous operation after exhaustion of the onboard light water solution.

Operation of the TAU-3 is relatively simple, but, because this vehicle is still in the evaluation stage, only the leading particulars are being presented at this time.

LEADING PARTICULARS

| | |
|---|---|
| Height (less driver) | 40 in. |
| Height (average driver) | 68 in. |
| Width | 65 in. |
| Length | 175 in. |
| Wheel base | 91 in. |
| Ground clearance | 8 in. |
| Turn radius | 196.5 in. |
| Max speed forward | 20 mph |
| Max speed reverse | 15 mph |
| Weight loaded | 12,500 lb |
| Weight empty | 8,800 lb |

Capacities

| | |
|---|---|
| Diesel fuel | 27 gal |
| Light water solution | 400 gal |
| Dry chemical | 200 lb |

## CRASHES

There are four general classes of aircraft crashes aboard an aircraft carrier: on deck, catwalk, suspension (over the side), and in the water. Each crash must be handled differently, depending on the situation. No standard procedure will apply to all crashes. The primary consideration must be for a ready deck for all airborne aircraft. When possible, an aircraft with a known problem should be landed last. This does not preclude situations that require immediate recovery, such as in-flight fires, impending loss of control due to hydraulic system failure, toxic fumes in the cockpit, etc.

When time is essential, the easiest and fastest method is used regardless of additional damage that will occur to the aircraft. When time is not essential, care is taken to ensure that further damage does not occur. It is important that the Crash Salvage Officer or the Crash Salvage Chief be left in full control of clearing a crash from the deck. Squadron maintenance personnel should be outside the perimeter if their assistance is requested.

Since fire is an ever-present danger in all aircraft crashes, each crash must be approached as though the aircraft was on fire. When an aircraft crashes, the impact is usually such that fuel lines and fuel tanks become ruptured. If the aircraft is not already on fire when it comes to rest, fuel fumes are likely to be ignited by hot engine parts, sparks, or electrical shorts.

Since the rescue of personnel in a crash is normally the first objective of the rescue crew, fog-foam nozzles must be trained on the cockpit area and other crew stations to protect the plane crew until rescue can be effected. Upon direction from the crash officer, the hot suit men move in to effect rescue of personnel. Rescuemen should approach the aircraft with due regard for danger areas. If the aircraft is actually on fire, these men must be protected with fog foam and water fog as applicable.

Rescue and forcible entry are discussed later in this chapter. Detailed instructions for each type aircraft are covered in its technical manual (General Information and Servicing section) and in the U.S. Navy Aircraft Firefighting and Rescue Manual, NAVAIR 00-80R-14.

### Catwalk

The rescue of personnel and the fighting of fire in crashed aircraft in a catwalk is somewhat more complicated than an on-deck fire due to the difficulty in getting to the aircraft. The direction of approach is also limited due to the location. Assistance may have to be given to rescuemen in getting to the aircraft. There is also greater danger of ignited fuel running down the side of the ship and into the compartments below the flight

deck. Firefighters from other repair parties may be required to aid in fighting these fires.

### Suspension Over the Side

An aircraft suspended over the side can present a major problem in rescue of personnel and in firefighting. Care must be taken to prevent the aircraft from being dislodged. A preventer (line of sufficient strength to hold the weight of the aircraft) must be attached to or passed around a part of the aircraft to hold it as soon as possible. Rescue and fire-fighting operations may have to be made from the hangar deck. Line should be passed to the aircraft crew to assist them from the aircraft. At times it may be necessary to send a rescueman to the aircraft to effect the rescue of injured personnel. The method of getting rescue personnel to the aircraft depends on the location of the aircraft, the type of aircraft, the condition of the aircraft, etc.

### In the Water

When an aircraft crashes into the sea in the vicinity of a ship which is underway, the aircraft siren is sounded from primary fly control. This is followed by "crash in the water (port/starboard) side," passed from primary fly control over the 5MC announcing circuit.

Whenever flight operations are being conducted, the LSO stations a man on the port walkway and a man on the starboard walkway at the afterend of the flight deck. Each station is equipped with the following equipment:

1. Two-man liferaft.
2. Liferings.
3. Dyemarkers.
4. Sealed electric float lights (for night or low-visibility operations only).

These men are instructed to drop this equipment, without further orders, into the water if a crash occurs in the water on their side of the ship. The equipment must be dropped in the vicinity of the crashed aircraft. In no case should the equipment be dropped so close to the aircraft or personnel in the water that there could be danger of its striking them.

Since it is not normally practicable for a carrier to interrupt air operations in order to effect a rescue, the ship's helicopter or vessel in company nearest the scene of the crash takes appropriate action. If the helicopter and vessel in company have not observed the crash, they are notified by the carrier to proceed with rescue operations.

Most aircraft crashes at sea affect the carrier flight deck in some way, whether it was an on-deck, suspension over the side, or into the water crash. Some in-the-water crashes are from aircraft that attempted a landing, then crashed, and continued over the side. A check of the flight deck must be made for damages to the deck and/or equipment, for parts of the crashed aircraft, and for injured personnel before giving a clear deck for the continuation of landing operations.

### Salvage and Jettisoning

As in the combating of crash fires, the specific action to be taken in clearing the flight deck can only be determined after an on-the-spot analysis of the crash situation. In any event, the time element usually proves to be a very important factor. Crashes that interfere with flight operations must be cleared by the most expeditious means available.

On-deck crashes that render the landing gear inoperable may be removed by supporting the aircraft on one or more dollies. Automotive jacks or mobile cranes may be used to lift the aircraft in order that these dollies can be placed under the aircraft. The dollies must then be secured to the aircraft by means of lines or straps. The aircraft can then be towed or pushed clear of the landing area.

Catwalk crashes and overside suspensions present many and varied problems. Depending upon the situation, various items of crash equipment will be used (sometimes all the equipment available).

The steps in recovering a crashed aircraft vary considerably, depending upon the situation. Basically, they will consist of righting the aircraft so that it can be hoisted or mule-hauled (bodily dragged) up on deck.

The location, attitude, and condition of the aircraft to be jettisoned, time available to perform the jettisoning operation, and the equipment on hand with which to work are some of the problems confronted by the ABH when jettisoning an aircraft.

The aircraft to be jettisoned may be in an inverted position on the flight deck, have one wheel in the catwalk, two wheels in the catwalk, or it may have the landing gear completely sheared off.

The situation and problems vary with each aircraft; therefore, no single step-by-step procedure can be given that would be applicable for use in every case where an aircraft is to be jettisoned. Common sense and resourcefulness are important assets in such operation.

In general, the jettisoning operation is carried out as follows:

The aircraft to be jettisoned is placed on the outboard edge of the nearest deck edge elevator. The safety netting around the elevator must be dropped so the aircraft will clear it. If feasible, the ship then executes a high-speed turn to port or starboard, depending on which side of the ship the aircraft to be jettisoned is located. The execution of this turn creates a list to the ship which in many cases will be sufficient to cause the aircraft to be jettisoned to clear the deck edge elevator, and at the same time minimizes the possibility of jettisoned aircraft becoming fouled in the ship's screws.

If the list to the ship created by this maneuver is not sufficient to cause the aircraft to clear the elevator, or if it is not feasible to maneuver the ship in this manner, the aircraft may be pushed clear utilizing the aircraft mobile crash crane.

## FUELS

Flammable materials and fire-accelerating materials carried in each aircraft are of major concern to the crash crew. They include: gasoline and jet fuel, grease and oil, oxygen, hydraulic fluid, and anti-icing fluid. Of these materials, gasoline and jet fuel constitute the greatest problem in aircraft firefighting because of their susceptibility and ease of ignition, fire severity after ignition, and the firefighting or control measures needed to contain them.

Although there are differences in the properties of the different fuels now in use, it should be understood that under aircraft crash-impact conditions where fuel mists (fuel-air mixtures) are created following tank failure, all of the fuels are readily ignitable.

There is so little difference in the heat of combustion between the various aircraft hydrocarbon fuels that the severity after ignition is of no significance from the fire safety point of view. The firefighting and control measures are the same for the entire group of hydrocarbon fuels.

### Fuel Tank Hazards

When dealing with fuel tanks it should be remembered that a full, or nearly full, tank of fuel is relatively safe from ignition since the vapors, and not the liquid itself, will burn, while the tank space immediately above the liquid is so rich in gasoline vapors that ignition will not occur. On the other hand, JP-4 fuel is more hazardous than gasoline in this respect. It has a lower vapor pressure than gasoline. Therefore, in closed containers the space above the liquid usually contains enough air to form an explosive mixture which can be set off by a spark or flame. For both fuels, expansion can occur forcing vapors outward. If the mixture at the vent is of the correct air-fuel vapor proportions, it will (if ignition sources are present) burn in the case of gasoline, or explode in the case of JP-4.

### Ignition of Aircraft Fuels

To better understand the readily ignitable property of aircraft fuels, consider the accepted definitions of the physical characteristics of flammable liquids.

FLASH POINT.—The flash point of a liquid is the temperature at which sufficient vapors are emitted to form an ignitable mixture with the air near the surface of the liquid or within the vessel used. An ignitable mixture is a mixture within the explosive range that is capable, when ignited, of the propagation of flame away from the source of ignition.

IGNITION TEMPERATURE.—The ignition temperature differs from the flash point in that it is the minimum temperature required to ignite or cause self-sustained combustion independent of the heating or heated element. Aircraft fuels, like most flammable liquids, can burn only within a certain concentration range when mixed with air. Thus, there exists a minimum, or too lean, concentration of vapor below which propagation of flame does

not occur on contact with an ignition source, and likewise a maximum, or too rich ratio of vapor to air above which similar flame propagation cannot occur. These limiting mixtures of fuel vapor with air are known as the lower and upper explosive or flammable limits of the fuel, and at these two points the mixture will just propagate flame. Ignition and subsequent burning can occur in the range between these two limits. The low value of the flash point of all modern aircraft fuels thus renders them easy to ignite and burn or explode. The low minimum explosive of flammable limits of these fuels makes them additionally hazardous.

The ignition temperature of the aircraft fuels is relatively low enough for the application of appropriate safety practices with regard to exposure of their flammable liquids to high temperatures. It does not necessarily require a spark or exposed flame to ignite aircraft fuels.

When, through any internal or external source of heat, the temperature of an aircraft fuel vapor-air mixture within the flammable limits is raised to its ignition temperature, burning or an explosion will occur.

The temperature produced by the burning of vaporized aircraft fuel and air is intense, approximately 1500° F. Heavier oils may have greater heat retention properties but are much more difficult to ignite than aircraft fuels. When a heavier lubricating oil is combined with gasoline, as frequently occurs in aircraft fires, the aircraft fuel serves to provide ignition. It raises the temperature of the oil to the flash point, producing additional flammable vapors from this new fire source.

BACKFLASHES. — When aircraft-fuel fire is extinguished, leaving unburned fuel present, vapors will rise from the ground or liquid will float exposed upon the surface of any ponded water which remains from the fire-fighting operations. This surface is readily ignited from any open flame or from heated objects which, although not actually burning themselves, may still be hot enough to raise the fuel temperature to the ignition point. Reignitions of this kind are termed "backflashes" and are characteristic of, and should be watched for in, aircraft fuel firefighting.

These backflashes may occur during progress of a fire behind firefighters in areas in which extinguishment was thought to be complete, or they may occur at any other point following complete extinguishment of an entire area. The viscous foam produced by the modern crash trucks, however, does not readily break down when applied to the fire area as a blanket of adequate depth, so that fuel exposure and occurrence of backflashes for a considerable period following rescue operations is reduced. Backflash is to be most seriously considered where agents such as carbon-dioxide, or dry chemical which do not provide permanency of fuel cover, are the only available extinguishing medium.

However, the introduction of the Twinned Agent Unit (Light-Water and Purple-K-Powder) into the Navy firefighting systems has greatly reduced the possibility of backflash. This unit combines the quick flame knockdown capability of P-K-P with the vapor-securing and blanketing-ability of light water which provides rapid and lasting flame extinguishment.

GASOLINE VAPORS. — Gasoline vapor is heavier than air and consequently passes slowly downward to ground level or any lower surface. It spreads out and follows the surface to low points, flowing in the same manner as a liquid. Accumulations of vapor will spread over a flat surface, flow downstairs, or drop through openings in structures or crevices in the ground. These vapors gradually mix with the air, but if not affected by drafts they may remain in low spots for a considerable time. The bulk of the vapors in such low spots or flowing along the ground may be too rich to burn when first released. However, there will always be, on the outer regions of the rich mixture, a part of the vapor which has mixed with sufficient air to be within the combustible or explosive gasoline vapor-air mixture limits.

If ignition does not occur at this time, the richer vapors will slowly diffuse with the air until a flammable mixture exists over a considerably increased area. This increases the possibility of ignition, resulting in burning or explosion. The larger quantity of diffused mixture within the flammable limits, the larger the resultant fire or explosion will be if the mixture is ignited.

A flame has been reported to have traveled 162 feet along the path of gasoline vapors, returning to the source of gasoline and igniting it. For this reason, spills or discharges from

gasoline tanks or tank wagons must be regarded as potential hazards and steps taken to prevent their spread, accumulation in low areas, and ignition through accidental causes.

Jet fuels JP-5 and JP-6 are generally known as kerosene grade fuels. These fuels do have some handling advantages with regard to ignition temperatures, flash point, and vapor pressures. However, under aircraft crash-impact conditions where fuel mists are created following tank failures all of the fuels are readily ignitable. Crash impacts are known to cause severe vaporization or atomization of the fuel due to rapid rate of deceleration of the aircraft and splitting open of tanks which releases the fuel. This fuel "mist" in air ignites readily regardless of the theoretical advantages of the kerosene grade fuel.

For the precautions to be observed when handling aircraft engine fuels, see Military Fuel Operations Handbook, Standardization H.201 with latest amendments.

## CREW ENTRAPMENT AND RESCUE

With new, modern aircraft being introduced into naval aviation, many design changes have resulted that affect personnel (Aircrew(s)) rescue procedures under emergency operations. Supervisory personnel are responsible for keeping themselves and their crash rescuemen up-to-date on these changes and modifications. Lack of this information could result in fatal or serious injury to the rescueman as well as to those whom he is attempting to rescue.

Of necessity, this section is general in nature and does not include equipment, procedures, or modifications for each type aircraft, but rather to illustrate that rescuemen familiarization is the responsibility of, and must be accomplished by, the supervisor in his ever-changing and continuous training curriculum.

The supervisor should include in his training curriculum as a minimum the following suggested topics (for each type aircraft), as well as information of changes and/or procedures gained through his own research study, and experience:

1. Aircraft description.

   a. General identification of: mission, crew, engines, armament and ordnance stores, and type of ejection system(s).

   b. Interior of aircraft arrangement: fuel, oil, hydraulic fluid, compressed air, and liquid oxygen tank location and capacity. Location and quantity of ordnance stores.

2. Danger areas:

   a. Engines (intakes and exhausts).
   b. Wheels.
   c. Canopies and ejection seats.
   d. Drogue gun.
   e. Weapons.

3. Cockpit entry for:

   a. Normal conditions.
   b. Manual conditions.
   c. Forcible entry.

4. Prevention of pilot suffocation: oxygen mask and helmet.

5. Crew release from seat for:

   a. Automatic.
   b. Manual.
   c. Cut or emergency conditions.

6. Firefighting techniques for:

   a. Engine pods.
   b. Aft fuselage compartments.
   c. Tailpipe.
   d. Wheel and brake assemblies.

7. Deactivation of:

   a. Battery.
   b. Engine.
   c. Ejection seats.
   d. Canopy.
   e. Face mask precautions.

8. Special tools:

   a. Hoisting slings.
   b. Jacking instructions.

9. Hoisting and towing under normal and emergency conditions.

10. Crash firefighting criteria:

   a. Rescue operations are the primary objective.

b. When an aircraft crashes, it is too late to make a study of the aircraft to determine the best methods of lifesaving and fire-fighting.

c. No fire hazard in or in close proximity to an aircraft is minor or slight enough to be ignored.

d. Be familiar with identification colors for aircraft tubing. Should tube cutting be necessary, do not increase fire hazard by mistakenly cutting tubing containing flammable fluids.

e. When entrance is gained, the first step is to determine crew and environmental conditions. Where immediate hazards are beyond control of rescuemen and time is limited, remove aircrew at once. In other cases it may be necessary or practical to reduce hazards first and thereafter remove personnel.

f. In a crashed aircraft, it is of immediate importance to see the master switch (battery switch) is placed in the "OFF" position.

g. The fastest removal from safety belt and shoulder harness is to operate the release catch itself, not cut the belts.

h. Extreme care must be taken in removing aircrewmembers if they appear to be injured; however, in no case should rescuemen delay in removing victims from dangerous locations, as there is always danger of flash fires.

i. Medical assistance should be introduced at the earliest possible time. Do not assume that occupants are uninjured or that they are beyond help.

j. No part of the aircraft structure should be moved unless it is absolutely essential to rescue operations.

FORCIBLE ENTRY TOOLS

Whenever possible, access by means of door openings or hatches should be used when rescuing flight crew personnel from crashed aircraft. These door openings and hatches may be opened from both inside and outside the aircraft. Cockpit canopies and emergency escape hatches are equipped with emergency release mechanisms. These release mechanisms may be operated from both inside and outside the aircraft. When actuated, most emergency release mechanisms allow the entire canopy, cockpit enclosure, door, or hatch to fall away. Thus, easy and speedy exit or access is facilitated.

If the emergency releases fail to operate, it becomes necessary to forcibly enter the cockpit. To accomplish this, in case of a Plexiglas or safety glass type of canopy, use is made of a standard hatchet-size fire ax.

Direct the pointed end of the ax on the canopy near the center of the bow. One healthy blow will knock a hole through the canopy. Chop down from the hole toward the sill, then along the frame. The canopy glass will break up into large pieces. If the aircraft is on fire and the canopy is soft and sagging, apply $CO_2$ to harden it before chopping. At normal temperature, $CO_2$ is not needed.

Extreme caution must be observed when canopies covering ejection seats are shattered, lest the blows actuate seat ejection mechanisms.

A portable, electrically-powered metal cutting saw of the type carried on the MB-5 crash rescue truck may be utilized when forcible entry of a nearly-all-metal type canopy is required. If a portable power saw is not available, the metal canopy can be chopped through with an ax and ripped apart with a Halligan tool.

Each activity that supports flight operations should designate one or more crash rescue vehicles to carry and be equipped with rescue and forcible entry equipment. The TAU vehicle, where provided, is ideally constructed as a rescue vehicle. The designated vehicle or vehicles should contain equipment suitable for either normal or forcible rescue of aircrew personnel.

The power saw and generator equipment includes a portable generator rated at 2.5 kw, 180 hertz, 230-volt, 3-phase ac; a 10-inch circular saw; and two 500-watt floodlights and necessary cable and connectors. The current produced by the generator permits operation of power tools under severe conditions which would stall conventional equipment, and also permits the use of more compact, lighter weight tools. Tools, lights, switches, and connectors are explosionproof and weatherproof. The generator, which is also weatherproof, has four service outlets; two outlets supply 230-volt, 3-phase ac for the circular saw; the other two furnish 110-volt ac for the floodlights and other conventional tools.

NOTE: This power forcible entry equipment should be subjected to rigid and frequent

inspection for operation and should also be restricted for the exclusive use of aircraft fire and rescue operations.

SOURCES OF INFORMATION

As stated previously, there are many different sources of information available concerning aircraft fire/rescue. The senior ABH will find these sources very valuable in maintaining an effective training program for fire/rescue crews aboard ship, as well as on shore stations. These sources include, but are not limited to, the following:

1. NAVAIR 00-80R-14, U.S. Navy Aircraft Firefighting and Rescue Manual. The Crash Crew information charts in sections 6 and 9 are of special interest for rescuemen.

2. Type Aircraft Technical Manual—General Information and Servicing section.

3. Squadron and/or Base Aviation Safety Officer.

4. NAVAIR Instruction 11320.8 (Series), Aircraft Firefighting and Rescue Training Course Outline.

5. Navy Safety Center, Norfolk, Virginia.

6. NAVEDTRA 10300 (Series), Aviation Boatswain's Mate H 3 & 2.

# CHAPTER 5

# SHOREBASED EMERGENCY ARRESTING GEAR AND RELATED EQUIPMENT

By this time in your career, most of you have worked with one or more types of shore-based arresting gear. Normally, aboard ship, the ABH will not work with arresting gear, but once assigned to a shore station, his duties may include the operation, upkeep, and maintenance of that station's arresting gear. Therefore, this chapter has been incorporated for your use. It is imperative that ABHs familiarize themselves with the various types of emergency arresting gear and the related equipment in use today.

Normally, aircraft can land at a naval air station without the use of arresting gear as required by those landing aboard an aircraft carrier. In an emergency situation such as a

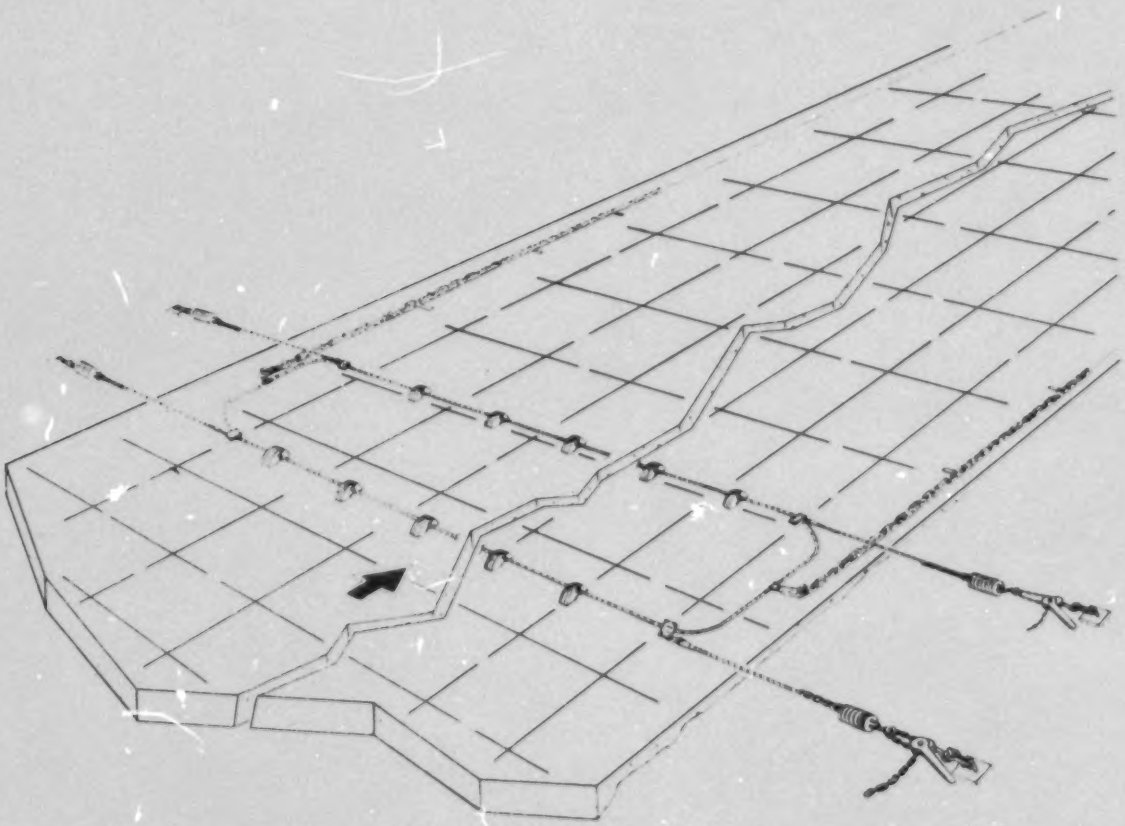


Figure 5-1.— E-5 field emergency arresting gear. 200.33

blown tire, an indication of the landing gear not locked, the pilot being sick, or any one of the numerous emergencies that could arise, it is desirable to arrest the aircraft and stop it in the shortest distance possible to minimize the chance of an accident that could cause injury to the pilot and crew or damage to the aircraft. Emergency shore-based recovery equipment has been designed for just such emergencies.

All emergency shore-based recovery equipment, except the MA-1A overrun barrier, has been designed to recover carrier and land-based aircraft equipped with tailhooks. The MA-1A overrun barrier is designed to stop aircraft not equipped with tailhooks but must have a nosewheel for the barrier to be effective. The MA-1A overrun barrier is always in a standby status in the event of an aborted takeoff, or an emergency overrun landing.

In this chapter the different types of emergency recovery equipment are covered. Some of these types have been in use for several years, while others are of the latest design.

Two principles are involved in the energy absorption characteristics of chain arresting gear. First, the chain must have sufficient unit mass and total weight to decelerate an aircraft to a stop within a reasonable distance. Second, the deceleration force must be applied at such a rate as not to overstress the arresting pendants or the aircraft arresting hook structure or to fail the aircraft main landing gear struts in the case of a barrier arrestment. The proper unit chain pickup (pounds/feet) and total chain length and weight fulfill these requirements.

## E-5 ARRESTING GEAR

The E-5 chain-type arresting gear (fig. 5-1 and 5-1(A)) has two deck pendants of equal length (length depends upon the width of the runway) stretched across the runway spaced 30 feet apart. Both ends of each cable are coupled together by a three-way coupling. A "D" ring chain connector is also connected to the three-way coupling on each side of the runway. The "D" ring chain connector connects the arresting cables to the chain. Each arresting cable has a cable clamp installed on each side of the runway. Working with these cable clamps is a link which connects the arresting cables to the anchor and tensioning pendants by means of a shear pin. Each arresting cable has a deadman anchor on each side of the runway. The deadman anchors are made of concrete

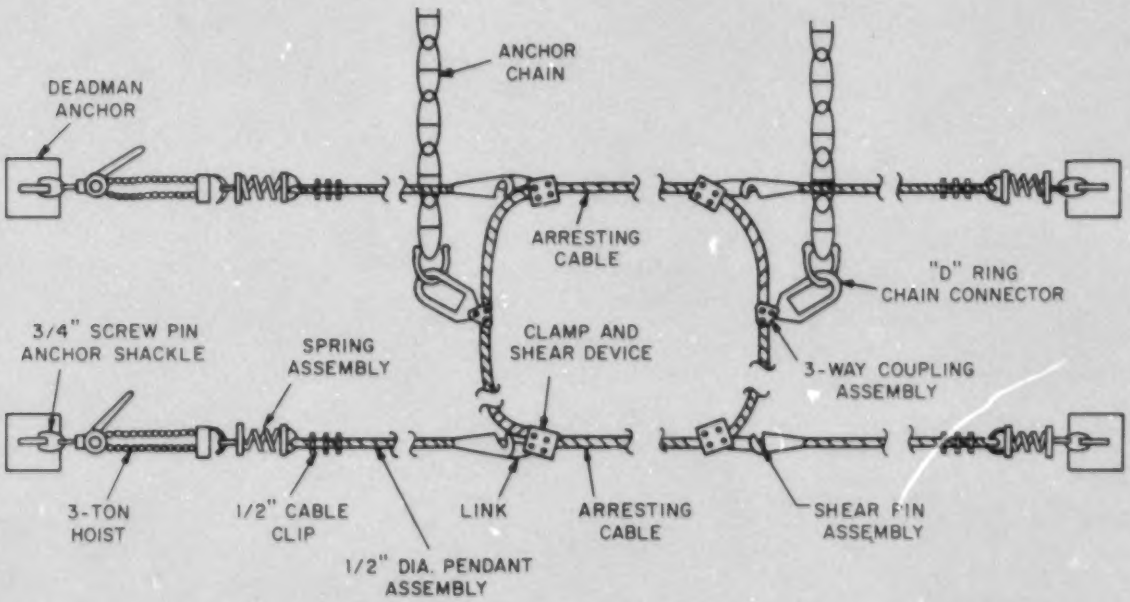



Figure 5-1(A).—E-5 dual "straight" arresting cable chain gear. 200.34

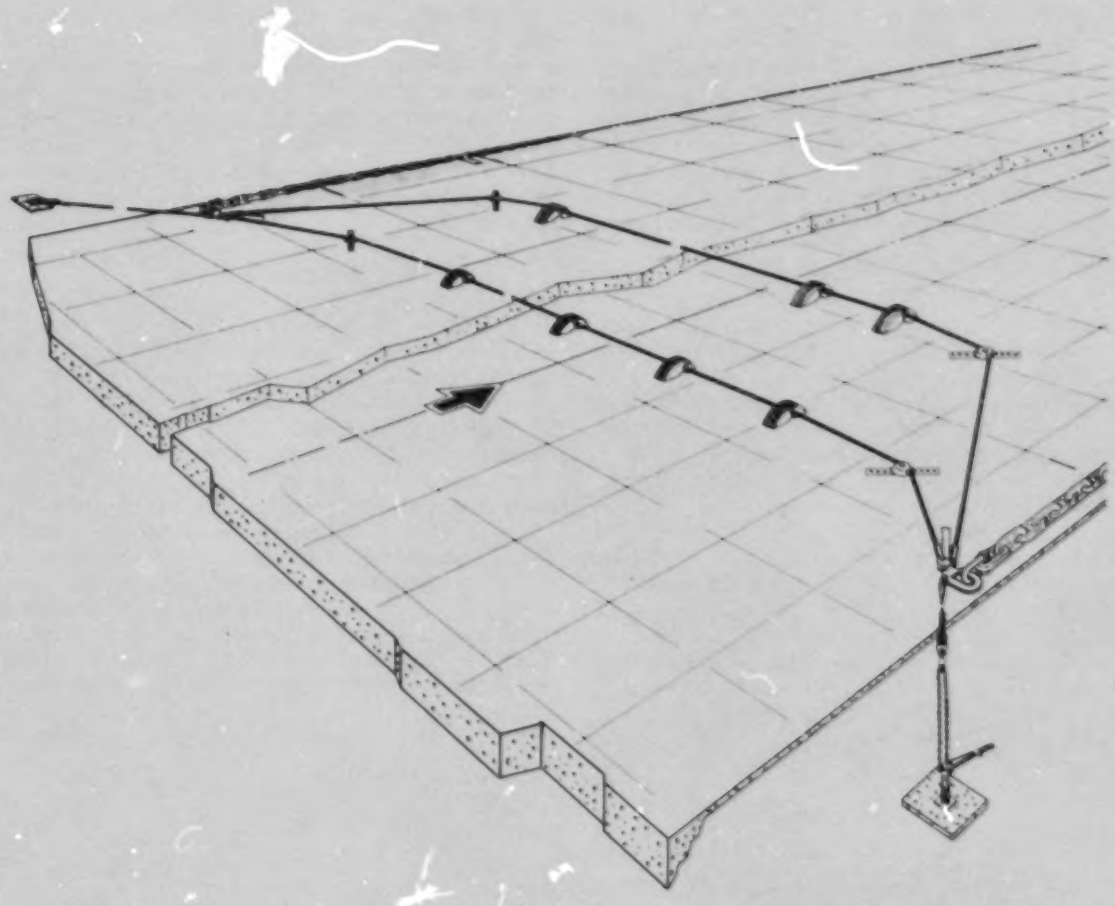


Figure 5-2.— E-5 Mod 1 field emergency chain arresting gear. 200.35

poured into a hole located 15 feet from the side of the runway. These anchors are installed by public works personnel or a civilian contractor. To be acceptable the anchors must be able to withstand a minimum load of 10,000 pounds acting along the tensioning pendant from the anchor.

The E-5 Mod 1 (fig. 5-2 and 5-2(A)) is similar to the E-5 arresting gear, except the two arresting cables on the E-5 Mod 1 are of different lengths whereas the E-5 arresting cables are both the same length. This requirement stems from the E-5 Mod 1 arresting cables being shaped with the use of retention hooks that are bolted to the runway. The shaped configuration of the E-5 Mod 1 arresting cables causes the number 2 arresting cable to be longer than the number 1 cable. The exact length of the arresting cables is determined by the width of the runway. Since the retention hooks give the arresting cables their shape and hold them in place on the runway, only one dead man anchor on each side of the runway is required.

With both E-5 and E-5 Mod 1 gear, the energy of the landing aircraft is transmitted to the anchor chain by the engaged deck pendant. The aircraft catches one of the deck pendants with its tailhook, and at this time the shearpin in the tensioning cable is broken. This releases the pendant from the tensioning system and causes it to be connected only to the chain. The chain along the runway is then towed down the runway by the aircraft. (See fig. 5-3.) This permits the transfer of the energy of the

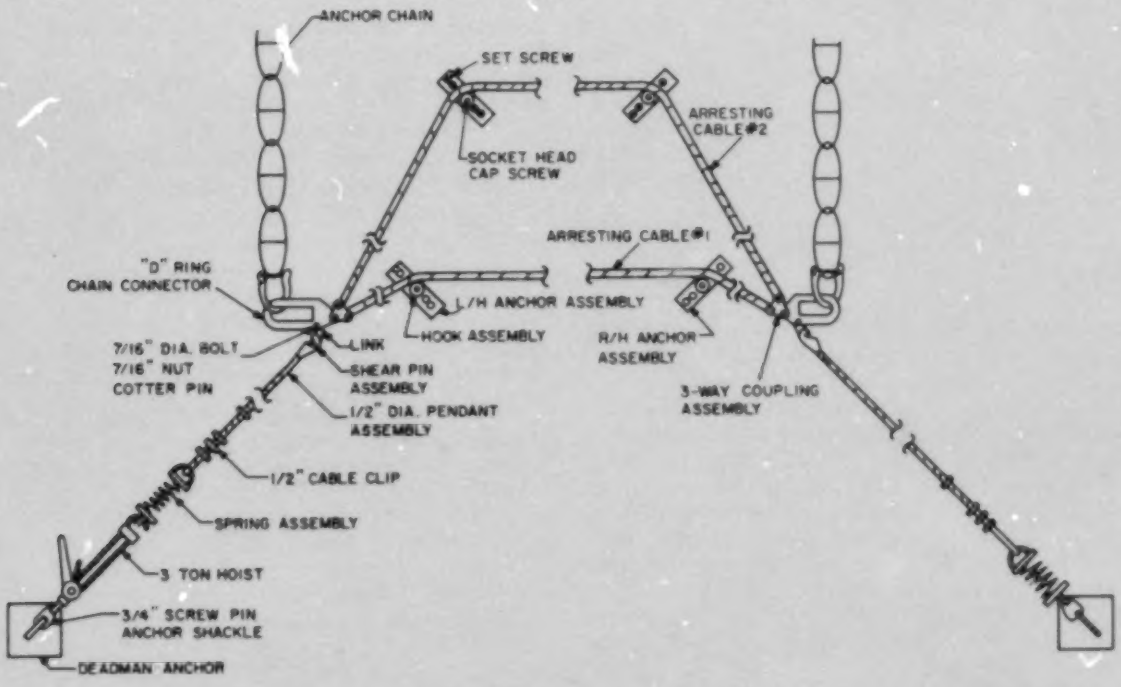
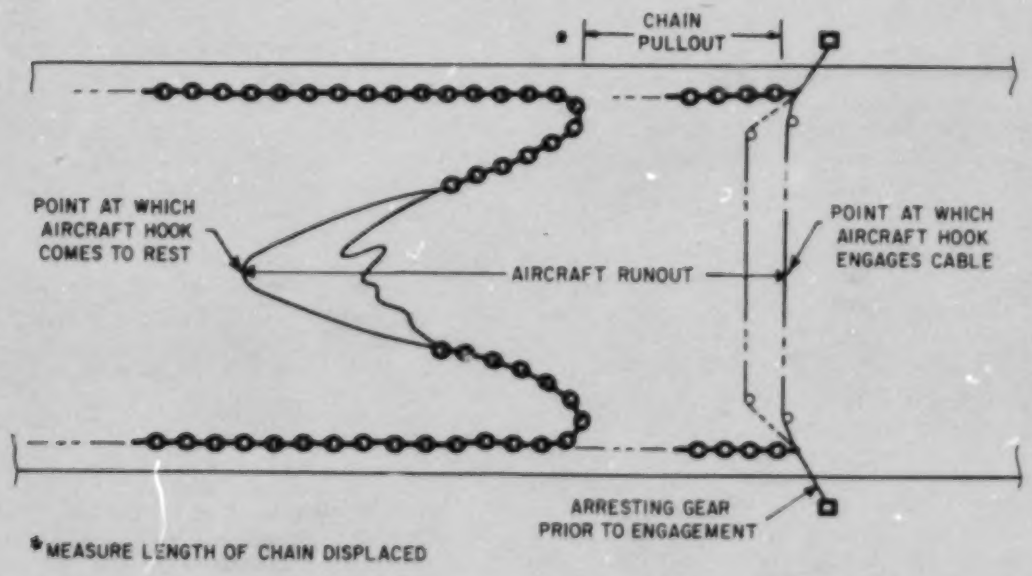



Figure 5-2(A).—E-5 Mod 1 dual "shaped" arresting cable chain gear. 200.36


CHAIN PULLOUT
POINT AT WHICH AIRCRAFT HOOK COMES TO REST
AIRCRAFT RUNOUT
POINT AT WHICH AIRCRAFT HOOK ENGAGES CABLE
ARRESTING GEAR PRIOR TO ENGAGEMENT
*MEASURE LENGTH OF CHAIN DISPLACED

195.112

Figure 5-3.—Sketch showing how to measure aircraft runout and chain pullout.

arrested aircraft to the chain. The arrangement of the chain allows it to pay out gradually, thus progressively increasing the weight pulled by the aircraft. The energy is dissipated by the gradual chain weight pickup until arrestment is complete. Then the aircraft is disengaged from the gear and the gear is put back in battery position.

To make it easier to position the wire supports properly when operating with chain-type arresting gear, stripes are painted on the runway at the proper locations.

Marks are usually painted along the edge of the runway at 10-foot intervals to facilitate measuring aircraft runout and the length of chain pulled out. An alternate method of marking is paint marks of the chain at 10-foot intervals. Highly reflective colors should not be used, because they might distract the pilot.

The E-5 Mod 2 field emergency arresting gear is basically the E-5 gear with the chain so arranged as to allow pendants to be rigged at either end of the chain. Similarly, the E-5 Mod 3 is basically the E-5 Mod 1 with the chain also arranged to allow pendants to be rigged at either end.

When the E-5 Mod 2 or E-5 Mod 3 arresting gear is installed, the chain configuration builds up from the smallest permissible weight chain to the heaviest weight allowed for the type of aircraft being operated and then drops down in weight to the opposite end of the chain.

NOTE: Only one set of arresting cables is rigged on an E-5 Mod 2 or E-5 Mod 3 installation at a time. The downwind cables are rigged and when the wind shifts, requiring a runway change, all that has to be done is remove the cables that are upwind and install the downwind cables.

CAUTION: Failure to remove the upwind cables on an E-5 Mod 2 or E-5 Mod 3 installation could cause severe damage to the aircraft in the event an aircraft engages one of these cables in the wrong direction.

## CAPABILITIES AND LIMITATIONS

The maximum recommended engaging speed for E-5 or E-5 Mod 2 chain gear is 150 knots and for the E-5 Mod 1 and E-5 Mod 3 gear 165 knots. Both of these figures are for oncenter engagements. Offcenter engagements exceeding one quarter of the runway span may result in cable failure and/or the aircraft veering off the runway. The chain length and its weight determine the maximum aircraft runout capability of an arresting gear. An emergency chain arresting gear bulletin gives the recommended minimum chain configurations for operating with aircraft weighing above or below 30,000 pounds.

There are times that the least potential hazard to a pilot is an in-flight engagement of the gear. Such an engagement would probably be at a speed above the rated limit for that type of gear. There are isolated instances where successful arrestments have been accomplished at engaging speeds in excess of the rated limit.

The same arresting energy absorption and engaging speed characteristics that apply to emergency landings also apply to an aborted takeoff. The arresting gear is an assist to stop the aircraft and to prevent it from rolling off the runway and on to unprepared surfaces. Of prime importance are the initial chain mass, the proper chain, and properly installed and maintained components.

## INSTALLATION OF CHAIN ARRESTING GEAR

Many factors should be considered in the selection of location(s) for one or more emergency chain arresting gear installations. Figure 5-4 shows a typical field arresting gear layout. The runout requirement is one of the main factors considered when selecting a location for installation of field emergency arresting gear.

An E-5 or E-5 Mod 1 located at or near the end of the runway has the advantage of providing maximum aircraft rollout in case of an aborted takeoff or an excessive landing speed. If an E-5 or E-5 Mod 1 cannot be installed at or near the end of the runway due to limited available runout area and/or interference with taxiways etc., an E-5 Mod 2 or E-5 Mod 3 may be located in the center of the runway to permit landings to be made in either direction by using the arresting cables on the approach end of the gear and removing the cables on the upwind end.

All arresting gear installations, when first installed and prior to being used, must be inspected and certified by the NAVAL AIR ENGINEERING CENTER. Any modification or change in an arresting gear installation makes reinspection and recertification mandatory.

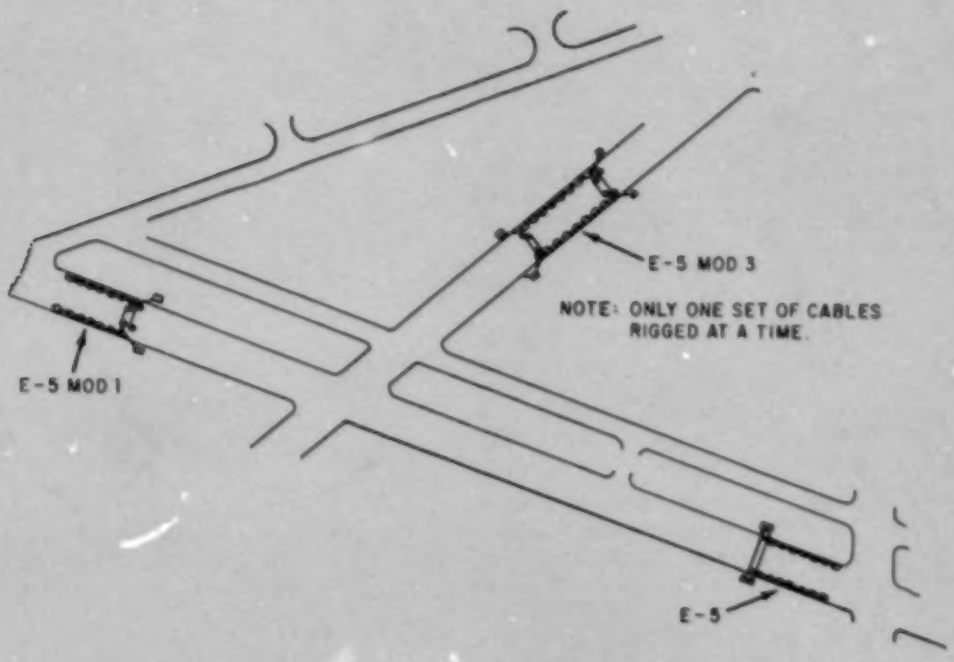



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Figure 5-4.—Typical field arresting gear layout.

The tower should always be kept informed of the status of the gear. Incoming aircraft should be informed of the location of, capability of, and other information pertinent to the emergency arresting gear. Aircraft engagements at velocities in excess of the capabilities of the gear will probably result in aircraft damage and pilot injury. Excesses in engaging speeds can also result in broken chain or hardware which become missiles, thereby increasing the potential damage to property and personnel. Always evacuate all possible personnel from the areas adjacent to the duty runway during aircraft arrestments.

## ARRESTING GEAR COMPONENTS

### Pendants and Cables

The deck pendants used with the E-5 and E-5 Mod 2 arresting gear consist of 1-inch diameter preformed wire rope of 6 X 19 filler wire construction. To determine the correct length of the deck pendants, add 20 feet to the width of the runway. For example, if the runway is 200 feet wide, it would require deck pendants 220 feet in length. The cable clamps must be installed according to the figures found in the applicable bulletins for E-5 and E-5 Mod 2 chain gear. Proper installation of the cable clamps must be made to ensure that slack or kinks in the deck pendant between the cable clamps and the coupling to the chain are eliminated.

The E-5 Mod 1 and E-5 Mod 3 deck pendants are also 1-inch diameter preformed wire rope of 6 X 19 filler wire construction. However, the deck pendants are of different lengths because the E-5 Mod 1 and Mod 3 gear use only one anchor on each side of the runway and the pendants are placed around retention hooks to space them 30 feet apart on the runway. The correct lengths of the deck pendants for the E-5 Mod 1 and E-5 Mod 3 gear are found in the applicable bulletins.

An inspection of the deck pendants is conducted daily to determine if the arresting cable has incurred any damage as a result

of aircraft or other vehicles traveling across them.

Also, after each engagement the cables must be inspected. The arresting cable inspection and replacement criteria are as follows:

1. If the engaging speed is less than 100 knots and the aircraft runout distance is less than 500 feet, the cables may be inspected in the installed position.

2. If the engaging speed is from 100 knots to 150 knots inclusive and/or the aircraft runout distance is over 500 feet, remove both cables and thoroughly inspect them. Cables that pass inspection may be put back in service. Upon reinstallation, the cables must be reinspected to make sure they have not been damaged by handling or dragging on the runway.

3. If the engaging velocity exceeds recommended speed, mark the engaged cable. Remove both cables and scrap the engaged cable. Thoroughly inspect the cable which was not engaged. If it passes inspection, reinstall it. Upon completion of the reinstallation, reinspect the cable for damage from handling or from contacting the runway surface.

4. Scrap any cable engaged offcenter over one-fourth of the runway span. Cables must be replaced when inspection reveals signs of broken wires, when they are kinked, crushed, burned, or excessively worn, or as a result of age. No cable may remain in service for more than 8 months. See figure 5-5 for cable wear and damage.

To prevent cable deterioration, coat with a corrosion preventive compound (MIL-E-16173 Grade 1). Cables that are located in an overrun area may be coated liberally; however, cables located on the runway should be coated sparingly to prevent accumulation on the runway surface.

Cable Supports

Cable supports are used to facilitate engagement of the arresting cable by the aircraft's arresting hook. The wire supports on emergency field arresting gear are the donut wire supports. The reason they are called donut wire supports is that they are shaped like donuts. The donut wire supports are made of rubber and are installed onto the deck pendant with a special donut wire support

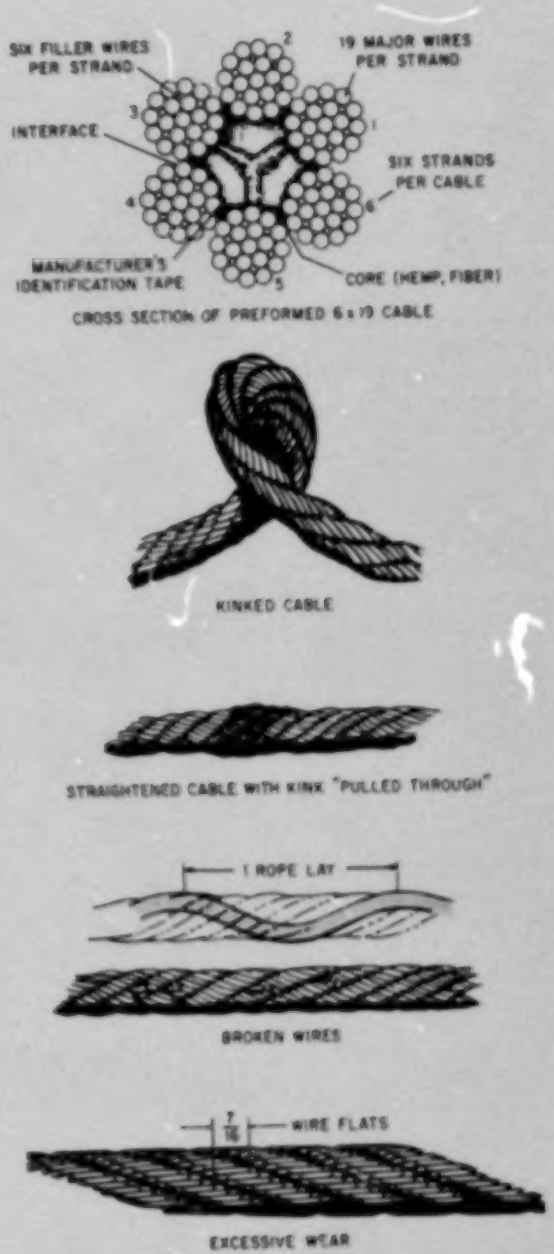


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Figure 5-5.—Cable construction, damage, and wear condition.

installation tool (fig. 5-6). When installing donut wire supports on a pendant use the following steps:

1. Place the donut wire support installation tool beneath the pendant terminal and pin the tapered cone to the terminal as shown in figure 5-6.

2. Apply grease, specification MIL-G-7711A, to the inside wall of the hole in the donut wire support, the tapered cone, and the pendant terminal.

3. Install the donut wire support on the tapered cone and pin the cone to the installation tool as shown in figure 5-6.

4. Using the hand lever, jack the tapered cone and the pendant terminal through the hole in the donut wire support utilizing the full stroke of the rack.

5. Repeat steps 2 through 4 for each donut wire support required.

6. In order to reduce the length of cable over which the donut wire supports must be turned in order to position them on the pendant, install one-half of the required supports over each terminal using the above procedures.

CAUTION: Pushing the donut wire support along the pendant without turning it may reduce the ability of the support to retain its position on the pendant.

NOTE: Installation of donut wire supports on one or more spare deck pendants is recommended in order to provide a capability for immediate pendant replacement when required.

The minimum number of wire supports installed per deck pendant on the chain-type arresting gear is eight. When positioning the supports on the pendant, one support should be installed 9 feet from the runway center line with the opposite support installed 5 feet from the center line. All other supports located beyond the two center supports should be 14 feet apart. The configuration of the supports are reversed for the number 2 pendant.

After the original donut wire supports have been installed and positioned on the pendant and have been approved, paint marks on the runway at the support locations. This will expedite repositioning of the supports, if necessary, following an arrestment.

The supports are staggered between the two arresting cables to lessen the probability

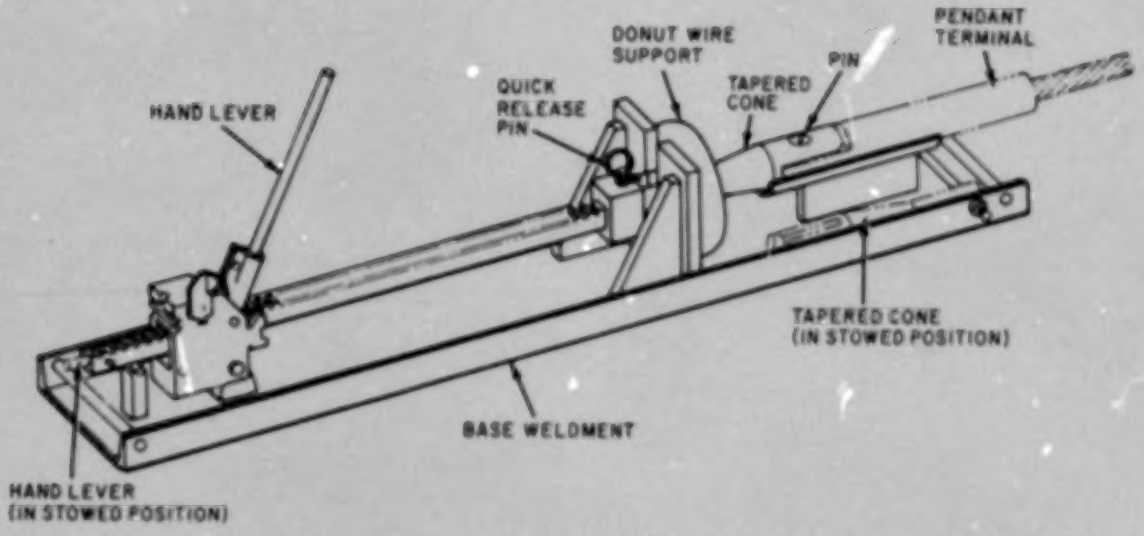


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Figure 5-6.—Donut wire support installation tool.

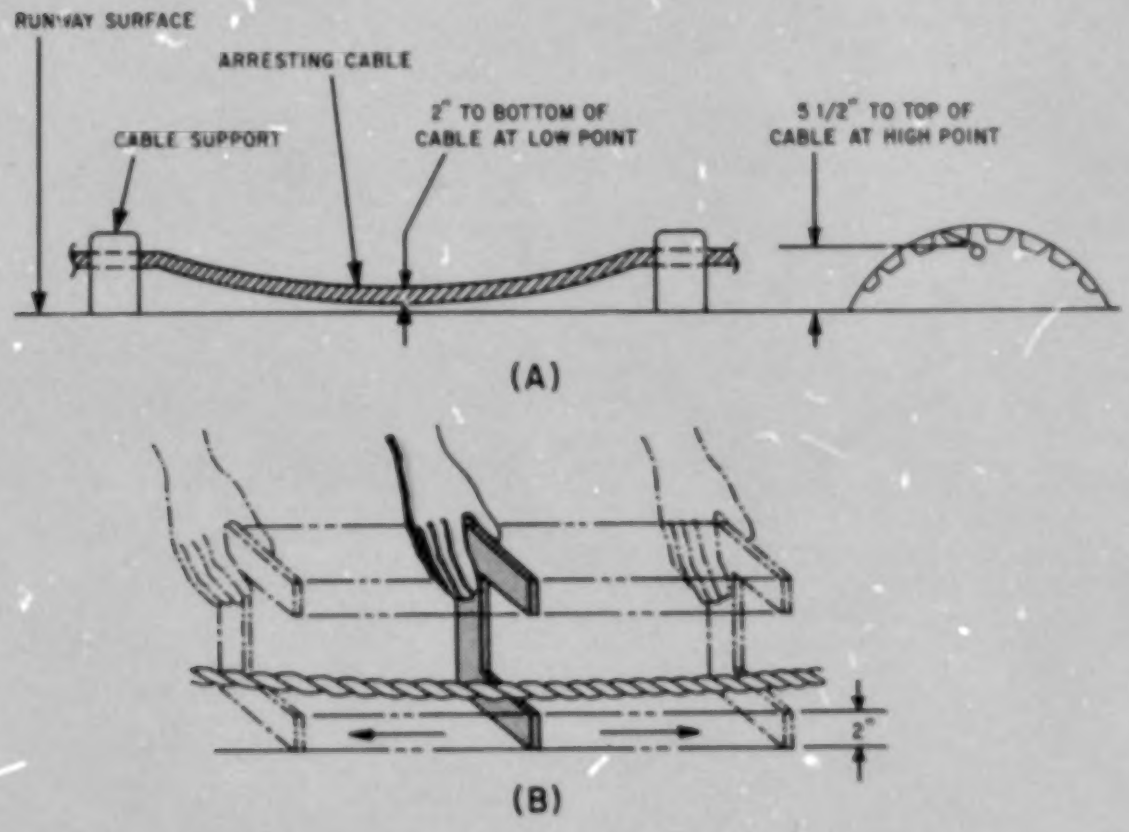


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Figure 5-7.—(A) Arresting cable height criteria; (B) Checking minimum pendant height.

of an arresting hook striking successive supports, thus failing to engage a deck pendant. The height of the bottom of the arresting cable between supports should be a minimum of 2 inches above the surface of the runway. (See fig. 5-7 (A) and 5-7(B).)

In the event that donut wire supports are unavailable, old aircraft tires (10 to 24 ply) can be used. See table 5-1 for acceptable tires for use as cable supports. Automobile tires do not hold up well, necessitating frequent replacement. Truck tires in most cases are too wide and provide too great an obstruction on the runway; therefore, their use is not recommended. The wire beads may be removed from the tires to facilitate bending the tire sections when they are inserted on the arresting cable. See fig. 5-8.

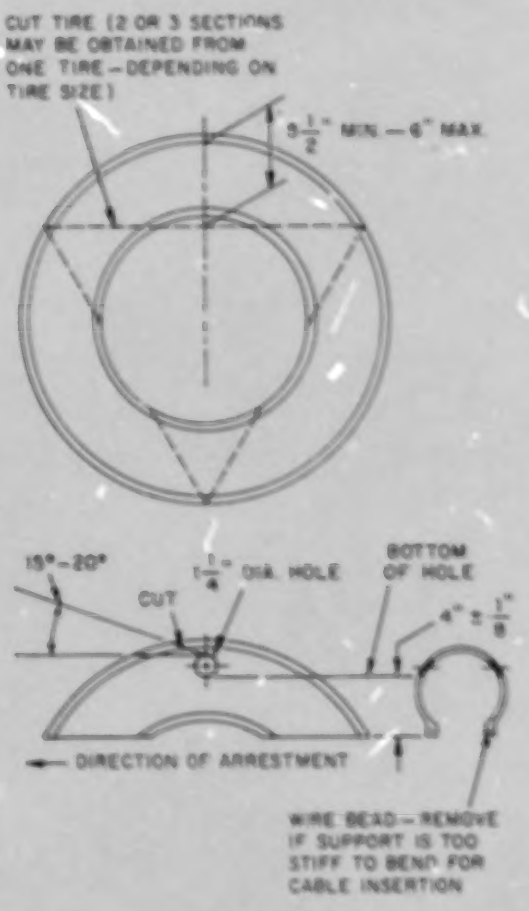
For information concerning manufacture of aircraft tires for deck cable supports, consult NAVAIR 51-5-28, Handbook Operation, Maintenance and Overhaul Instructions with Illustrated Parts Breakdown, E-5 and E-5 Mod 1, dated 1 January 1974.

### Retention Hooks

Each type of E-5 Mod 1 and E-5 Mod 3 arresting gear employs four retention hooks (detail A, fig. 5-9) to hold a set of deck pendants in a prescribed geometric pattern. The hook is positioned by a dowel pin which enters a hole in the adjustable anchor.

Table 5-1.--LIST OF ACCEPTABLE AIRCRAFT TIRES FOR USE AS TIRE CABLE SUPPORTS

| Aircraft Model | Tire Size |
|---|---|
| A-4 | 18 x 5.5 Nose Wheel<br>24 x 5.5 Main Wheel |
| A-5 | 26 x 6.6 Nose Wheel |
| A-6 | 20 x 5.5 Nose Wheel |
| F-1 | 20 x 4.4 Nose Wheel<br>26 x 6.6 Main Wheel |
| F-3 | 24 x 5.5 Nose Wheel |
| F-4 | 18 x 5.5 Nose Wheel |
| F-6 | 22 x 5.5 Nose Wheel<br>26 x 6.6 Main Wheel |
| F-8 | 22 x 5.5 Nose Wheel<br>26 x 6.6 Main Wheel |
| F-9 | 18 x 5.5 Nose Wheel<br>25 x 6.0 Main Wheel<br>24 x 5.5 Main Wheel |
| S-2 | 18 x 5.5 Nose Wheel |


CUT TIRE (2 OR 3 SECTIONS MAY BE OBTAINED FROM ONE TIRE—DEPENDING ON TIRE SIZE)
5 1/2" MIN—6" MAX
15°-20°
1 1/4" DIA. HOLE
CUT
BOTTOM OF HOLE
4" ± 1/8"
DIRECTION OF ARRESTMENT
WIRE BEAD—REMOVE IF SUPPORT IS TOO STIFF TO BEND FOR CABLE INSERTION
TIRE SUPPORT IS POSITIONED WITH CUT AWAY FROM DIRECTION OF ARRESTMENT
BEND TO INSERT WIRE CABLE

200.38

Figure 5-8.—Details of cable supports from tires.

After each engagement of the arresting gear, the retention hooks must be inspected for excessive throat wear and to determine that the hook has not rotated. Rotation indicates dowel pin failure. After every five engagements the hooks are to be removed and inspected for cracked, sheared, deformed, or loose dowel pins, and for throat wear. If none of these discrepancies is present, the hook may be placed back into service. Check the retention hook anchor assembly for position and security.

### Tensioning System

The tensioning system (detail A, fig. 5-9) consists of tensioning pendants, springs, cable clips, and a chain hoist. This system is used to produce sufficient tension to raise the arresting cables between the supports to the correct height required to ensure positive aircraft hook engagement. The tensioning system

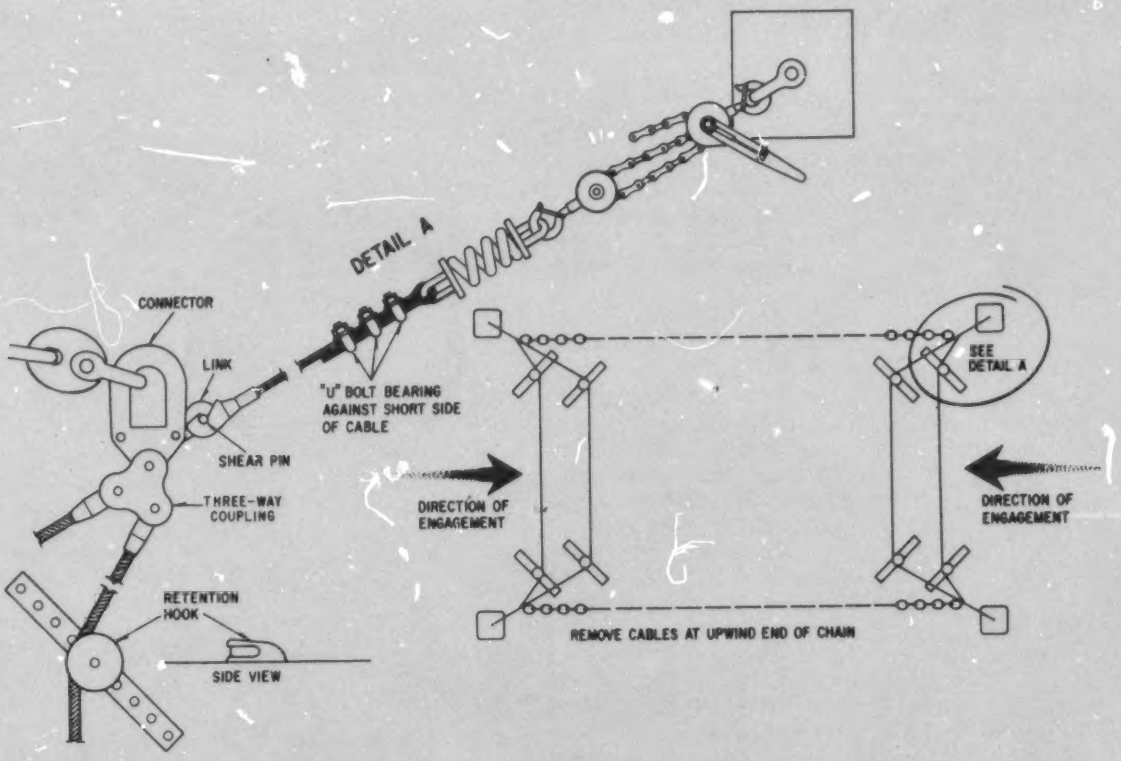



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Figure 5-9.— E-5 Mod 3 with detail of tensioning system.

must be inspected for serviceability and security a minimum of three times per day and after each arrestment.

The system is properly tensioned when the bottom of the arresting cable at the sag or low points is no less than 2 inches above the runway with the supports installed as stated earlier in this chapter. Too much tension will probably result in premature shearpin failure when aircraft roll over the cables.

Using the hoists to apply tension to the system, the two springs nearest to the hoists will compress faster than the two on the far side of the runway. To equalize the tension, the arresting cables should be vibrated by jumping on them between the arresting cable tire supports when the springs on the hoist side are compressed two inches.

Increase tension until two inches of compression are indicated on the springs at the far side of the runway. Jump on the arresting cables to equalize compression. Continue increasing tension and equalizing compression until two inches are indicated on both sides of the runway. If compression exceeds two inches on the far side of the runway springs, alternately release hoist tension and equalize compression until the required two inches are equally indicated on the tensioning springs on both sides of the runway. The arresting cables should now be properly tensioned and meet the required minimum height with the bottom of the cable, at the lowest points between the cable supports, 2 inches above the runway surface.

Chains

The chains used on chain-type gear are surplus anchor chains consisting of die lock,

stud, integral stud, and open link chains. The open link chain is acceptable only in the last 90 feet of chain configuration. All of these types are used, but wrought iron chain is not desirable. Chain usually comes in 90-foot lengths which are commonly referred to as "shots" of chain. When the chain is installed, it is imperative that corresponding shots of chain on each side of the runway are of identical weight and length. This does not mean they have to be of identical type. If chain of the weight specified for a specific location in the overall chain configuration cannot be requisitioned, it is permissible to lash shots of chain together to arrive at the specified weight.

To facilitate handling of chain links during inspection and replacement of chain, a hook of local design may be improvised. See figure 5-10(A). It may be made from a 1/2-inch-diameter steel rod approximately 3 feet long, bent at one end to form a hook. The opposite end should be fitted with a handle large enough for two-hand use. Also, a chain positioning device can be locally manufactured. The use of this device aids in removing twists and slack from the chain in preparation for the next aircraft arrestment. This device is used by anchoring one end of the chain with a tractor while pulling through the chain with the device attached to a tractor. Figures 5-10(B) and 5-10(C) show an example of a chain positioning device.

When chain is installed, it must not be looped, doubled back, or zigzagged to clear taxiways, runways, etc. The chain must be laid out in a straight line, 3 feet inboard and paraliel to the edge on the runway with all links taut (in contact lengthwise). There must be no slack in the chain, especially where it connects to the deck pendants with the specified hardware. The existence of slack in the chain increases impact loading which contributes to arresting cable and chain failure. Where the chain cannot lay in a straight line, a gradual fairing that maintains chain tautness may be employed. The chain must not be placed off the runway because, upon engagement of the arresting cable, the resultant dragging of the chain from the soil and across the runway edges may cause snaggling and subsequent cable failure. This also carries dirt and debris on the runway. In instances where the arresting gear is located on unpaved end zones, the area should be prepared to provide adequate support for chain, aircraft, and chain handling equipment in the event of an engagement.

RUNOUT REQUIREMENTS

Aircraft runout distance is measured from the point at which the aircraft engages the cable to where the aircraft arresting hook comes to rest. This distance, for maximum capacity arrestments, normally will be twice the chain length plus one-half the arresting cable length. The total chain length is based on energy dissipation factors. The runout is based on the stopping distance required for the aircraft weight and speed without moving the last link of chain. In the case of an A-3 aircraft, the recommended minimum available runout area is 2,300 feet. Aircraft runout should not be confused with chain pullout, which is the length of chain displaced, or doubled back, during an arrestment. (See fig. 5-3.)

To determine the maximum chain length that may be used for a given available runout area, determine the capacity of an arresting gear installation as follows: Take the available runout length; subtract 1/2 the arresting cable length from it; then divide the remainder by 2. This result, together with the desired arresting capabilities, will determine the maximum chain length that may be utilized by that arresting gear installation.

Thin ice coverage does not appreciably increase runout since the chain breaks up the ice. The effect of freezing of the chain to the runway is negligible.

It is estimated that the rebattery time for the heavyweight chain configuration is 45 minutes. This would be the time required for six men and one tractor (34,000-pound drawbar pull) and driver to rearrange the chain after an engagement and then rig the pendants. This time does not allow for removal of twist and slack in the chain, which would require an additional 20 minutes per side. Repositioning a standard-weight chain, approximately 30 minutes rebattery time, is much easier than repositioning a heavyweight chain. Thus, heavyweight chain should be used only when demanded by considerations previously noted.

## E-27 AND E-15 EMERGENCY RUNWAY ARRESTING GEAR

All types of E-27 and E-15 arresting gear installations are supplied with identical arresting

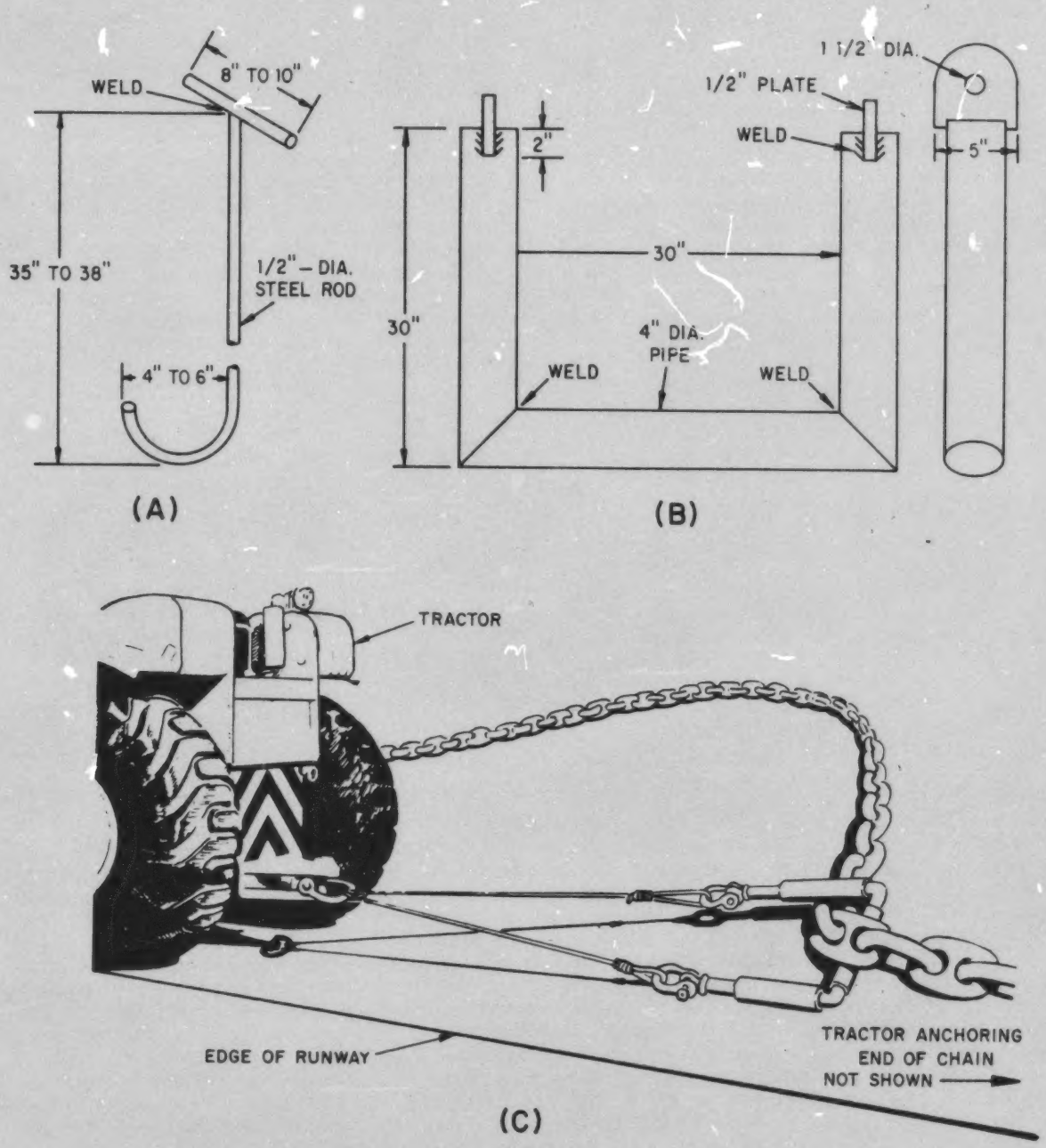


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**Figure 5-10.**—(A) Chain hook; (B) Chain positioning device; (C) Chain position device in use.

engines. Engine components are changed as necessary to suit individual installation arrangement requirements when the gear is installed at the field site.

There are various designations for the equipment to signify a difference in either the quantity of engines used or the installation configurations, or both. In other words, some installations have the engines installed in pits on each side of the runway, and some have just one engine on one side of the runway with the purchase tape led under the runway to the other side of the deck. Other installations have the units installed above deck.

Aircraft arrestment is accomplished by the engagement of the aircraft arresting hook with a deck pendant which spans the runway. During runout, the kinetic energy of the arrested aircraft is absorbed by the rotary friction arresting engine. The arrestment operation is entirely automatic. The arresting gear engine is activated when the aircraft arresting hook engages the deck pendant, thereby pulling out the attached purchase tapes. As the tapes unwind, the reels rotate, turning sprockets which simultaneously drive a hydraulic pump and rotate a valve cam. The pump supplies pressure to friction brakes; and the amount of pressure supplied is programed by the amount of restriction in a cam-control valve. The brake application decreases the rotational speed of the reels, thereby slowing down the purchase tape payout which in turn applies a braking force on the aircraft.

## SINGLE E-27 PIT INSTALLATION

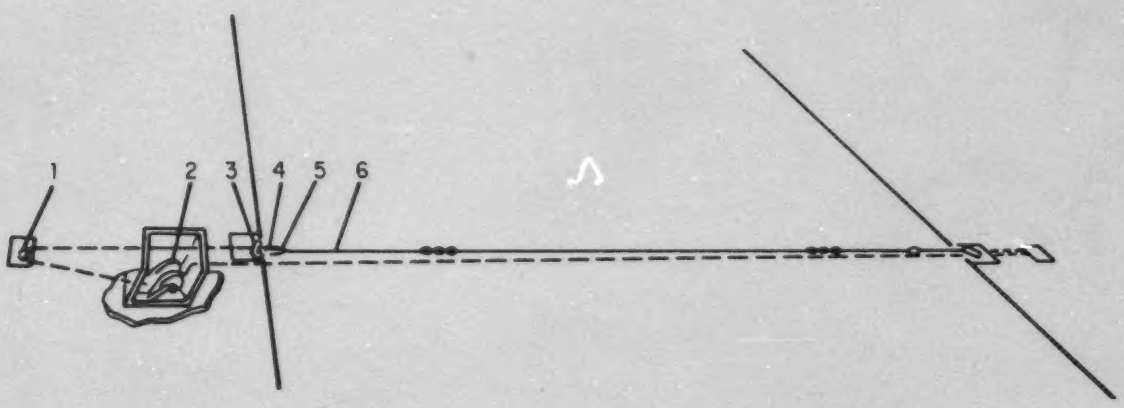
This installation (fig. 5-11) consists of a single pit installed arresting engine, operating with two nylon tapes. The tape from one reel is coupled to a crossdeck pendant in a conventional manner; the tape from the other reel is routed under the runway and coupled to the opposite end of the crossdeck pendant.

## E-15 ABOVE DECK SPLIT INSTALLATION

This installation (fig. 5-12) includes two arresting engines, one on each side of the runway. The engines are attached in parallel to one crossdeck pendant without crossing under the runway to make connections on the opposite side. This configuration uses two tapes on each engine attached to a single crossdeck pendant.

## E-27-1 ABOVE DECK SPLIT INSTALLATION

Two arresting engines (fig. 5-12) installed on opposite sides of the runway and operating




1. Deflector sheave assembly
2. Arresting engine
3. Runway edge sheave
4. Purchase tape
5. Tape connector
6. Deck pendant

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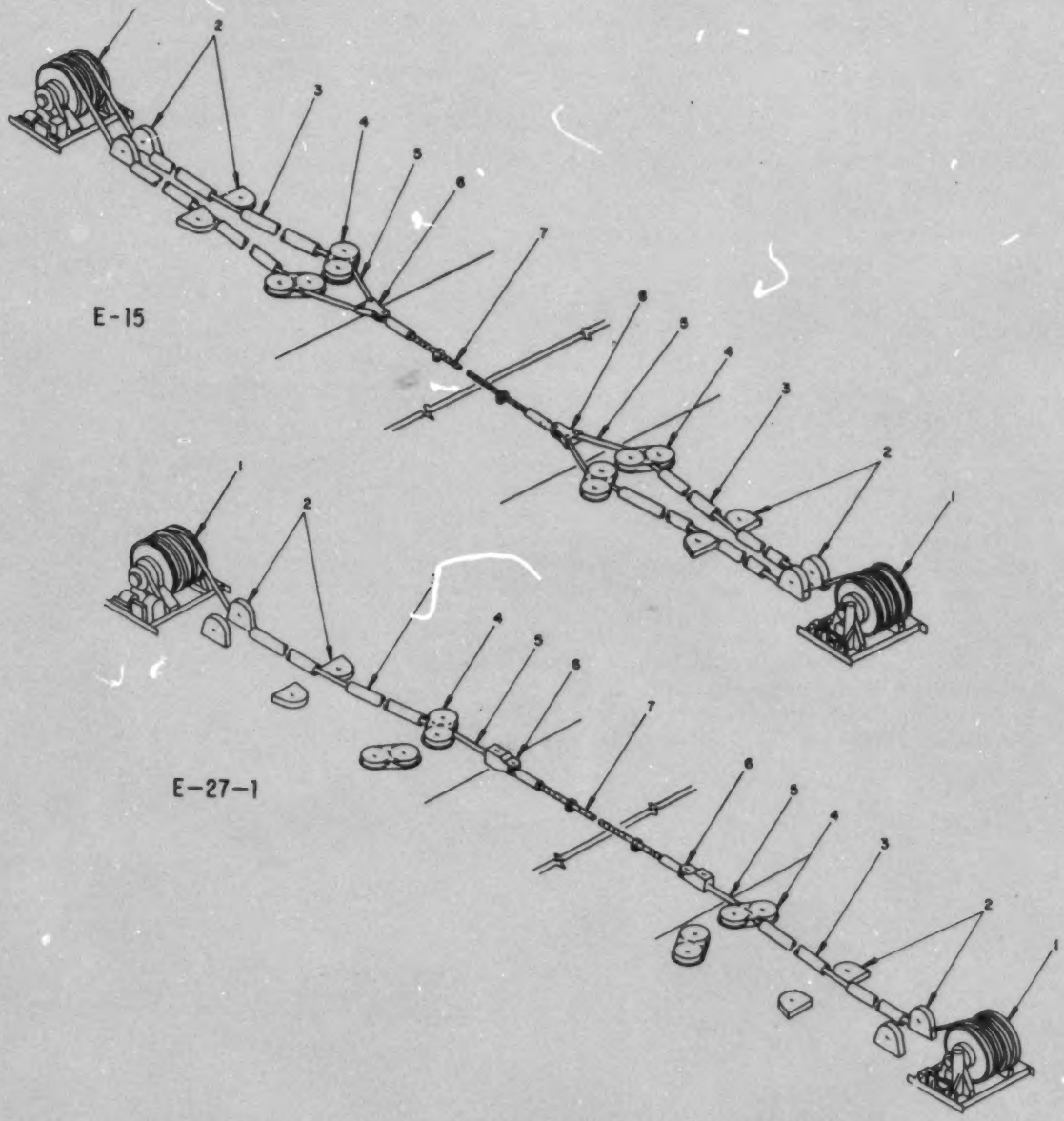
Figure 5-11.—Single E-27 pit installation.




1. Arresting engine
2. Deflector sheave assembly
3. Fairlead tube
4. Runway edge sheave assembly
5. Purchase tape
6. Tape connector
7. Deck pendant

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Figure 5-12.—Above deck installation.

with a single tape from each engine comprise this installation. Each engine is attached independently above deck to the crossdeck pendant. In both engines the hydraulic line to one of the two reel brakes is made inoperative to accommodate the single tape requirements of this type of arresting gear.

Aircraft arrestment with this type of gear is accomplished by the engagement of the aircraft arresting hook with a deck pendant which spans the runway. This gear can also be adapted to operate with the overrun barrier. During runout, the energy of the arrested aircraft is absorbed in the rotary friction arresting engine.

## ACCESSORY EQUIPMENT

### Single E-27 Pit Installation Only

The accessory equipment for this installation (fig. 5-11) consists of a deck pendant (6), two nylon purchase tapes (4), tape connectors (5), and sheaves (1 and 3). The deck pendant is stretched across the runway. The tape from one reel is coupled to the deck pendant above deck; the tape from the other reel is routed under the runway and then coupled to the opposite end of the deck pendant. The tapes, in turn, run through a series of runway and deflector sheaves and are wound on their respective reels.

### E-27-1 Above Deck Installation Only

The accessory equipment (fig. 5-12) consists of a deck pendant (7), one nylon purchase tape (5) for each engine, tape connectors (6), and sheaves (2 and 4). The deck pendant is stretched across the runway. The tape from each engine is attached independently above deck to the deck pendant by means of the tape connectors. The tapes, in turn, run through a series of runway and deflector sheaves and are wound on their respective reels.

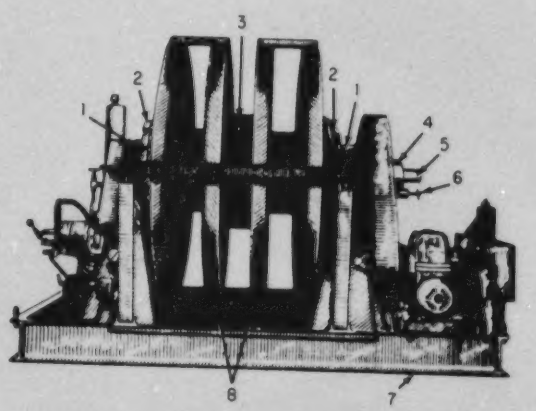
### E-15 Above Deck Split Installation Only

For this installation (fig. 5-12) accessory equipment consists of a deck pendant (7); four nylon purchase tapes (5), two for each engine; tape connectors (6); and sheaves (2 and 4). The deck pendant is stretched across the runway. The tapes from the two engines are attached above deck in parallel to the deck pendant by means of tape connectors. The tapes then run through a series of runway and deflector sheaves and are wound on their respective reels.

## ARRESTING ENGINE

The arresting engine (fig. 5-13) consists essentially of two tape storage reels (8), two multiple-disc brakes (2), and a third multiple-disc brake which acts as a clutch (3), mounted on a common shaft. After the components are assembled to the shaft, the unit is mounted on a welded steel base (7). The hydraulic components are mounted on one end of the welded base; the retraction equipment, on the other end.

When the reels and clutch are assembled to the shaft, the clutch locks the two reels and the shaft together causing them to function as a unit. The shaft rides in self-aligning roller bearings which are pressed on the shaft and housed by pillow blocks (1). The pillow




1. Pillow block
2. Brake
3. Clutch
4. Drive hub
5. Shaft
6. Rewind pin
7. Base
8. Tape reel

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Figure 5-13.—Arresting engine.

blocks act as supports for the shaft and reels. During an arrestment, the motion of the reels drives two sprocket wheels mounted on the shaft, thus providing power to the hydraulic system.

A drive hub (4) and a rewind chain and sprocket are mounted on the rewind end of the shaft. During an arrestment, the shaft is disengaged from the drive hub and runs free of the sprocket. Following arrestment, the drive hub is manually engaged by means of the rewind pin (6) to one of a series of mating holes. The sprocket is chain driven by the electric motor or gasoline engine, which is the power source for rewinding the tape onto the storage reels. The rewind pin is designed to fail if inadvertently left engaged when an arrestment is made.

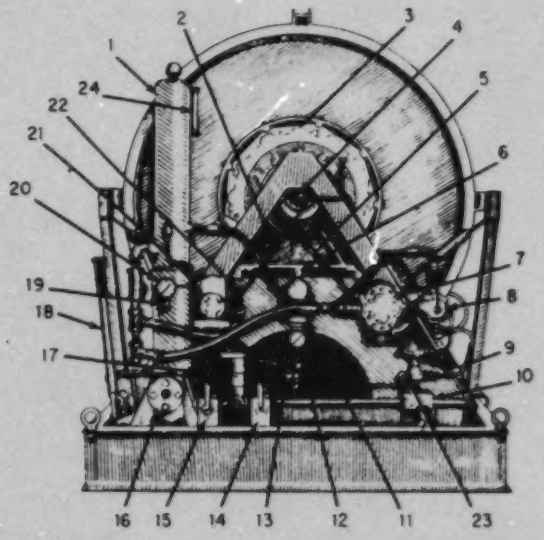
Hydraulic System

A closed, recirculating-type hydraulic system is supplied as part of the arresting engine. Figure 5-14 illustrates the components of the hydraulic system.

The reservoir and static brake pressure accumulator assembly (1, fig. 5-14) serves a dual purpose. The upper half is a gravity fluid reservoir which stores the hydraulic fluid. The lower half is a nitrogen charged accumulator which supplies static brake pressure to the system. A sight glass (16) located at the bottom of the accumulator section indicates the fluid level in the accumulator.

The pressure gage (20) and nitrogen charging valve (19) are assembled to the accumulator charging port. The accumulator is charged through the nitrogen charging valve (19). The gage indicates pressure within the accumulator.

The manual hydraulic pump (18) is used to adjust the fluid level in the brake accumulator and clutch accumulator. Normal pump action will transfer hydraulic fluid from the reservoir through the fluid transfer selector valve to either accumulator. To return fluid from the brake accumulator (1) back to the reservoir, the fluid transfer selector valve (15) is placed in BRAKE position and the fluid is bled through the bypass valve on the manual pump. To return fluid from the clutch accumulator (11) back to the reservoir, the fluid transfer selector valve (15) is placed in CLUTCH position, and the fluid is bled through the bypass valve on the manual pump.




1. Reservoir and brake static pressure accumulator assembly.
2. Roller chain (cam drive)
3. Brake
4. Rotary joint
5. Roller chain (pump drive)
6. Nitrogen charging valve (clutch)
7. Hydraulic pump
8. Pump selector valve
9. Piloted shuttle valve
10. Relief valve
11. Clutch accumulator
12. Clutch static pressure gage
13. Clutch accumulator charging valve
14. Static selector valve
15. Fluid transfer selector valve
16. Sight glass
17. Cam control valve
18. Manual hydraulic pump
19. Nitrogen charging valve (brake)
20. Brake static pressure gage
21. Cam gear reducer
22. Cam
23. Clutch shuttle valve
24. Fluid level gage

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Figure 5-14. — Arresting engine hydraulic system.

When the static valve (14) is in the CHARGE position, static pressure from the brake accumulator is routed to the piloted shuttle valve (9) which, in turn, directs this pressure to the multiple-disc brakes (3). When the static selector valve is in the DUMP position, the brake accumulator is blocked, and static pressure on the brakes is released.

Fluid from the reservoir is directed to the clutch accumulator (11) through the fluid transfer selector valve (15). By placing the fluid transfer selector valve in the CLUTCH position and placing the clutch accumulator fluid charging valve (13) in the open position, fluid is directed to the clutch accumulator. By placing the fluid transfer selector valve in the BRAKE position, the clutch accumulator is blocked and fluid is directed to the brake accumulator.

The clutch accumulator (11) is a bladder-type accumulator. Fluid pressure is directed from the accumulator to the clutch shuttle valve (23), to the rotary joint (4) and then, through a hole drilled in the shaft, to the multiple-disc clutch.

The clutch accumulator (11) is precharged with nitrogen through the nitrogen charging valve (6) located on the top of the accumulator.

The hydraulic pump (7) is a tandem oil gear type of pump which delivers fluid to the brake system when the tape reels rotate during an aircraft arrestment. The pump selector valve (8) permits either primary pump pressure or primary and secondary pump pressure to be introduced into the system. The roller chain (5) from the overrun clutch assembly sprocket on the pump shaft at the primary pump end drives the pump. As rotational speed of the main shaft increases, pump output increases. System pressure is controlled by the cam control valve (17). The system is protected from overpressure by a relief valve (10) which, when activated, routes fluid from the system to the gravity fluid reservoir. During retraction, the reels turn in the opposite direction which disengages the overrun clutch assembly, thus preventing hydraulic pump operation.

The piloted shuttle valve (9) subjects the multiple-disc brakes (3) to brake static pump, or atmospheric pressure, depending on the particular phase of operation.

In battery position, the clutch shuttle valve (23) permits static pressure from the clutch accumulator (11) to be supplied to the clutch. When sufficient pressure is developed by the hydraulic pump (7) during arrestment, the clutch shuttle valve spool shifts. This isolates the clutch accumulator (11) and exposes the clutch to pump pressure. When hydraulic pump pressure drops below clutch accumulator pressure, the shuttle valve spool shifts back to the battery position with static pressure again supplied to the clutch.

Fluid pressure in the hydraulic system is programmed by the cam control valve (17). The position of the cam (22) is related to reel rotation by means of the cam gear reducer (21) and drive chain (2). In battery position, the zero index of the cam is aligned with the cam follower.

Arresting gear retraction is accomplished by means of a special torque electric motor (3, fig. 5-15). The motor transmits power through a fluid coupling (4) to a speed reducer gear (7).

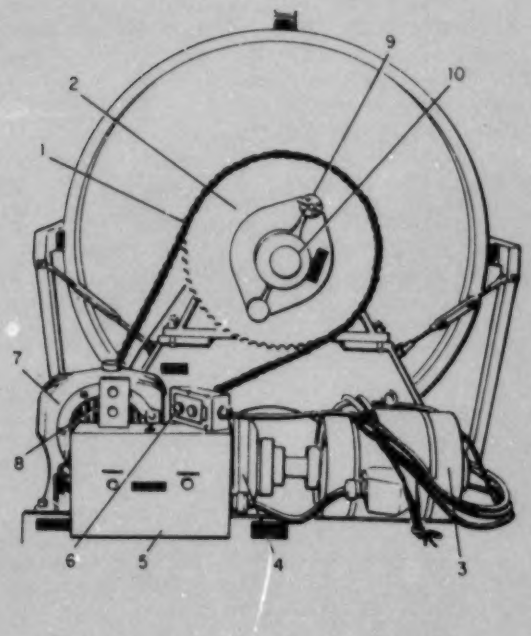
The speed reducer gear is linked by a chain (1) to the drive hub and sprocket assembly (2) attached to the shaft. The motor is operated by a pushbutton (6) or (8) and the motor starter (5), which is connected to the motor junction box. The electrical equipment is supplied as part of the arresting engine.

Supplied with the arresting engine is a telltale hydraulic gage which is installed in the brake hydraulic circuit to record the maximum hydraulic brake pressure reached during an arrestment.

## PREOPERATIONAL PREPARATION

For each arresting engine in the arresting gear installation, the following preparations must be made prior to each day's operation. (See fig. 5-15.)

1. Engage rewind pin (9) by manually positioning hub (10) until rewind pin is aligned with one of the series of mating holes in the sprocket (2). Turn spring-loaded rewind pin handle and allow the pin to seat in the groove of the drive pin cap. It may be necessary to manually turn the fluid coupling (4) to align holes.
2. Press the reverse pushbutton (6) or (8) to rewind any slack tape.
3. When tapes are fully wound and the pendant is taut, momentarily press the pushbutton on the piloted shuttle valve. This will




1. Chain
2. Sprocket
3. Motor
4. Fluid coupling
5. Motor starter
6. Pushbuttons (remote)
7. Speed reducer gear
8. Pushbuttons (local)
9. Rewind pin
10. Hub

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Figure 5-15.—Arresting engine (electrical system side).

port static tension to the braking system and maintain pendant tension.

4. Release the pushbutton to deenergize the rewind system.

5. Set the cam in battery position. This is accomplished by depressurizing the clutch accumulator, engaging the rewind pin, and operating the rewind motor until the cam zero mark (arrow) is directly above the cam follower, or by removing the cam drive chain and manually setting the cam. If the drive chain is removed, replace it before continuing operations. Disengage the rewind pin and repressurize the clutch accumulator.

6. Pull out the handle of the rewind pin until the pin is past the drive pin cap. Turn the pin until it rests in the shallow groove of the rewind cap; then release the pin handle.

7. Immediately after completion of the rewind operation, check the brake accumulator fluid level. If the fluid level is below the middle of the sight glass gage, use the hand pump to replenish. Pressure should be 175 (±10) psi.

8. Connect the hose to the nitrogen supply and charge the clutch accumulator fluid pressure to 1,000 (+000, -200) psi.

9. Set peak brake pressure gage to static pressure.

10. Set tachometer to zero.

The following preoperational checkoff must be completed daily and prior to each arrestment.

1. Pendant sufficiently pretensioned.
2. All pendant fittings checked for security.
3. Tape storage reel or reels fully wound with tape.
4. Tape taut—no slack in system.
5. Brake accumulator fluid at the center of the sight glass.
6. Brake accumulator pressure at 175 (±10) psi.
7. Brakes bled at all fittings.
8. Static selector valve handle placed in the CHARGE position. Proper brake application.
9. Fluid level in the reservoir approximately 2 inches from top of sight gage.
10. Brake lining measured with a depth gage—within limits.
11. Clutch pressure at 1,000 (+000, -200) psi. (Clutch accumulator has a precharge of 300-400 psi.)
12. Cam at battery position.
13. Rewind pin seated in the groove on the rewind pin cap.

## OPERATION

Operation of the arresting gear must not be attempted until all the preoperational checks have been made, and the preoperational checkoff list has been signed by the officer in charge.

The arrestment operation is entirely automatic; therefore, all personnel should be cleared from the arresting area prior to an aircraft landing.

In operation, as the aircraft arresting hook engages the deck pendant, the tape storage reels turn and the tape pays out. This action causes the energy of the aircraft to be absorbed by the braking action of the arresting engine or engines.

Following each arrestment the following postoperational check must be completed.

1. Examine deck pendant for broken wires, strand separation, and other damage. Causes for immediate deck pendant replacement are as follows:

a. Fifteen arrestments.
b. Engaging speed exceeding 160 knots.
c. Kinking.
d. Nine broken wires.
e. Five or more wires broken in one pitch length.
f. Hemp core visible.
g. Strand distortion.
h. Bird caging.
i. Excessive wear.
j. If installed for 6 months, regardless of condition.

2. Examine tape for visible damage. The wear on individual tapes as a result of runway abrasion will vary considerably, depending upon the exact condition of the runway surface. The tape is essentially a flat bag which contains longitudinal bundles of fibers. The fibers are the primary load bearing members. No attempt should be made to repair the tape. (See fig. 5-16.) If any of the following conditions exist, replace the purchase tape:

a. Damage to the tape of the nature of a lateral cut through the casing into the longitudinal fibers.
b. Abrasion of the casing which completely exposes any two adjacent longitudinal bundles.
c. Edge abrasion which completely removes the weaving reinforcement, exposing the first longitudinal bundle.

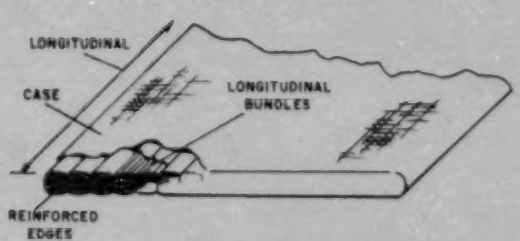


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Figure 5-16.—Purchase tape construction.

NOTE: Material used for the woven reinforcing edge is distinguishable by its kinky shape and is usually black, whereas longitudinal stuffers are straight and always white.

d. Purchase tapes that have been utilized for 20 arrestments.
e. Purchase tapes that have the equivalent of 30 arrestments in accordance with the criteria charts found in the technical manuals and bulletins.

3. Examine each arresting engine for fluid leaks.
4. Examine tape connectors for loose or missing bolts and nuts.
5. Examine tape loops for pulled or loose stitching.
6. Check engine reels for evidence of loose tape on reels or backlash.

During retraction, twists in the tape should not be allowed to pass through the deck sheaves and into the fairlead system. The arresting gear should be returned to battery position as quickly as possible after each arrestment. The retraction operation should be supervised by personnel operating the rewind motor, who must be in a position to clearly see personnel stationed at each sheave, the hook runner, and personnel operating the selector valve. If any tape twists or other abnormalities develop at any sheave location, or at an arresting engine emplacement, the retraction must be stopped immediately.

Procedures for retracting the arresting gear are as follows:

1. Disconnect the aircraft arresting hook from the deck pendant.
2. Place tape connector dollies under tape connectors to minimize tape wear in sewn loop area during retraction.
3. Engage the rewind pin by manually positioning the hub until the rewind pin is aligned with one of the series of mating holes in the sprocket. Turn the spring-loaded rewind pin handle and allow the pin to seat in the groove on the drive pin cap. It may be necessary to manually turn the fluid coupling to align the holes. Make sure the rewind pin is fully engaged before attempting to rewind the tape.
4. Make sure the brakes are disengaged.
5. Press the reverse pushbutton on the rewind motor to set the reel (or reels) in motion and rewind the tape to near battery position.

NOTE: If the pendant is severely offcenter, it can be corrected by holding the short side and rewinding the side pulled out the most. When they are even, retract both reels together.

6. Reduce the clutch pressure and rewind the purchase tapes to battery position, holding the deck pendant taut with the rewind motor slipping through the clutch. Repressurize the clutch.

7. Continue, following the steps 2 through 10 in the prelaunch preparation steps previously mentioned.

## MAINTENANCE PROCEDURES

All maintenance personnel must be instructed to bring to the attention of the officer in charge all cases of malfunction, wear, looseness, leakage, damage, or any other irregular conditions pertaining to the equipment.

Keep the equipment as clean as possible. Using a clean, soft cloth, wipe down daily to remove excess grease, dirt, and oil. Remove rust, and paint the equipment as often as necessary. Check frequently for leaks, and be constantly alert for any unusual sound or action of the equipment. Report any unusual conditions immediately.

The arresting gear must have a scheduled 30-day inspection. If the arresting gear has not been engaged on the day of inspection, exercise the equipment by pulling out the purchase tapes with a truck or tractor. Conduct a complete inspection of the rewind and drive system, purchase tape, brakes, and the hydraulic system.

## REPLACING PURCHASE TAPE

If you have a single E-27 pit installation, the only difference in the following procedure would be the purchase tape is led under the runway. Therefore, as the old tape is removed from the reel, tie a length of leader to the end of the tape that is removed from the reel. The leader must be of sufficient length to pull the new tape back under the runway and attach to the reel.

The following steps are to be followed when reeving above-deck installations.

1. Establish a permanent mark along the edge of the runway 1,050 feet from the centerline of the arresting gear.

2. Remove the cam drive chain and set the cam at zero.

3. Dump the brake static pressure. Reduce the clutch pressure to zero.

4. Pull out the tapes slowly with a tractor or truck to full length.

CAUTION: Do not pull tapes loose from hubs.

5. Cut tapes approximately 8 feet from the runway edge sheave.

6. Remove tape-to-pendant connector from the tapes by removing lock screws, nut, and connector pins. (See fig. 5-17, Detail B.)

7. Discard the pulled-out portions of the old tapes.

8. Place a tape reel stand adjacent to the runway slightly beyond the 1,050-foot mark.

9. Pull out the end of the tape from the shipping reel until it reaches the old tape 8 feet from the runway edge sheave.

10. Burn or punch 4 holes through each tape approximately 2 to 3 inches from ends, then lace the tapes together with parachute shroud line.

11. Repressurize the clutch to approximately 500 psi and retract the tapes until the sewn loops are positioned at the 1,050-foot mark along the runway.

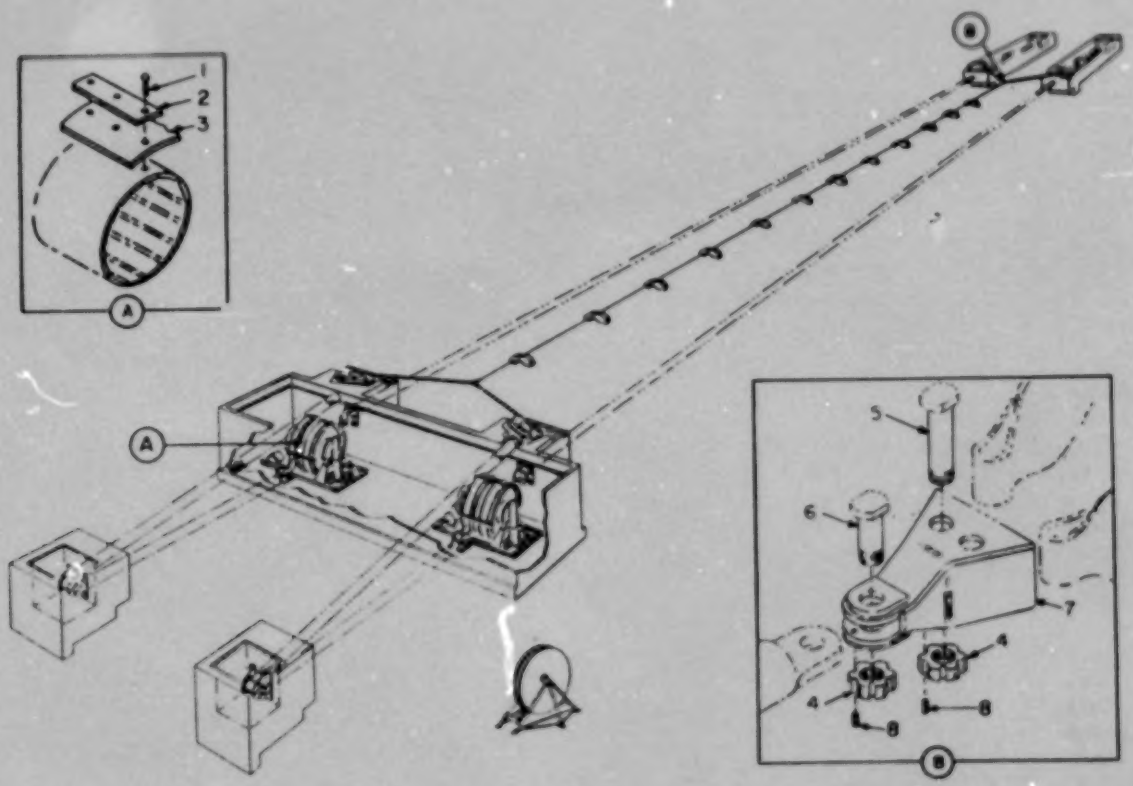
12. Remove slack in the tapes and mark tapes at a line tangent to the reel hubs. Retract approximately 6 feet more onto the hub, then reverse by pulling out the tape so that the marked tape will lie slack on the ground and can be cut.

13. Remove excess tape from the engine reels (old tape plus new tape). Discard the excess tape.

14. Using the tape clamp as a template, make holes in the new tape ends for the clamp bolts approximately 4 to 6 inches from the end of the new tape. This can be done with a heated rod. If this is not possible, a gasket punch may be used. Secure tape to reel hub with clamp and attaching hardware. (See fig. 5-17, Detail A.) Check security of attachments.

15. Retract new tapes onto tape reels until the first loop is approximately 20 feet from runway edge sheave assembly. Attach tapes to pendant with connectors, using pins, nuts, and tape installation tool. Secure with lock screws.

16. Center deck pendant on runway and hold it in this position. Reduce clutch pressure to




1. Screw
2. Tape clamp
3. Tape
4. Nut
5. Connector pin
6. Connector pin
7. Double tape connector
8. Lock screw

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Figure 5-17.—Tape and tape connections.

250 (±50) psi and retract tapes; this will equalize tape lengths on runway. Apply brake static pressure. Tape outer wrap height should be (1) within 1/2 to 1-1/2 inches from outer edge of tape reel at highest point, and (2) tapes on adjacent reels must be within 1/2 inch of each other with regards to stack height (measured from the other edge of tape reel).

17. Pressurize clutch to 800 (+200, -000) psi.

18. Replace cam drive chain after ascertaining that the cam is in the battery position.

19. Coat all surfaces of exposed tape, from runway edge sheave assemblies to tape connectors, with GACO.

Do not attempt to repair the tape connectors. If inspection reveals any evidence of cracks, sharp edges, deformation, or any other damage, replace the tape connector immediately. Do not allow the gear to operate with doubtful connectors. If any doubt exists as to whether damage warrants replacement, replace the connector and subject it to a more thorough examination at a later time.

The brakes in the arresting engine are replaced as complete assemblies. No attempt should be made to reline or otherwise service worn brakes locally.

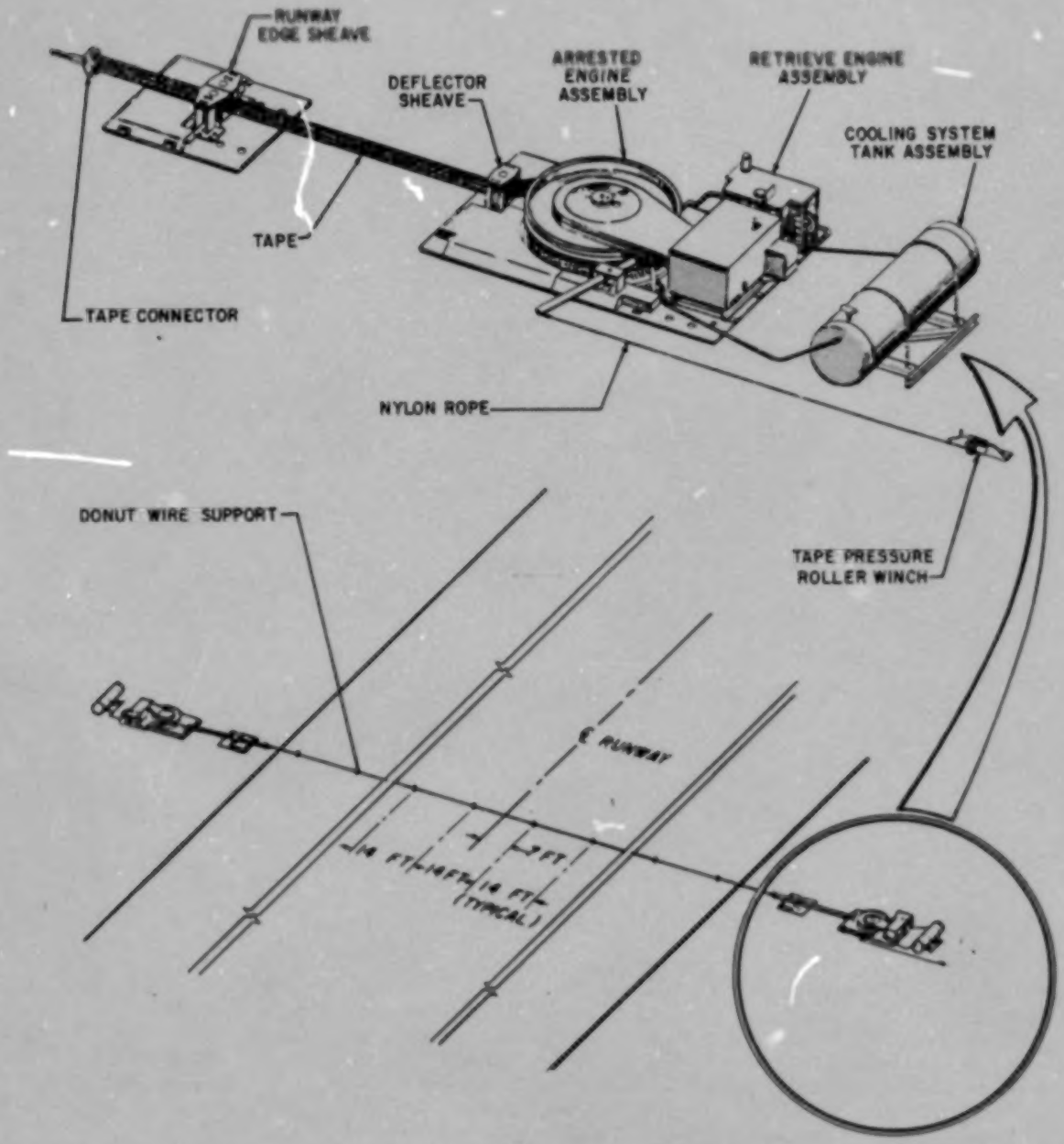


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Figure 5-18.— E-28 installation.

## E-28 EMERGENCY ARRESTING GEAR

The *E-28 emergency runway arresting gear* (fig. 5-18) installation described in this section is designed as a land-based emergency standby gear for arresting hook-equipped aircraft. The arresting gear is installed on the runway for the purpose of safely arresting an aircraft in the event of an aborted takeoff, or any emergency landing. The two arresting engines are rotary hydrodynamic energy absorbers and are designed to jointly dissipate the kinetic energy of a landing aircraft. The arresting engines are installed outside the edges of the runway.

### PRINCIPLE OF OPERATION

Aircraft arrestment is accomplished by engagement of the aircraft arresting hook with a deck pendant which spans the runway. During runout, the kinetic energy of the arrested aircraft is absorbed by the rotary hydrodynamic arresting engines. The arrestment is entirely automatic. The arresting gear engines are activated when the aircraft arresting hook engages the deck pendant, thereby pulling out the attached purchase tapes. As each tape unwinds, the drum, through the splined shaft, turns a vaned rotor between vaned stators in a housing filled with fluid. (See fig. 5-19.) The fluid resistance decreases the rotational speed of the drums, thereby slowing down the purchase tape payout, which in turn applies a braking force on the aircraft. The ensuing fluid turbulence converts the aircraft's kinetic energy into heat.

### DESCRIPTION AND FUNCTIONS

The E-28 arresting gear installation consists of two arresting engines installed above deck on opposite sides of the runway, and each operating a single nylon tape. The tape from each engine is routed through a deflector sheave and a runway edge sheave assembly, and is coupled by means of a tape connector to one end of the deck pendant. (See fig. 5-20.)

Table 5-2.—E-28 arresting-gear design characteristics

| | |
|---|---|
| Maximum aircraft weight accommodated | 78,000 pounds |
| Maximum aircraft engaging speed | 160 knots |
| Arresting engine | |
| Gross weight | 11,700 pounds |
| Length | 13 feet |
| Width | 8 feet |
| Height | 33 inches |
| Ambient temperature range | $-45^0$ to $125^0$ F |
| Fuel | Gasoline |
| Hydraulic fluid | Ethylene glycol and distilled water |
| Energy capacity | 76-million foot-pounds |
| Purchase tape | Nylon (8 inches wide, 0.344 inch thick) |
| Deck pendant | |
| Construction | 1 1/4-inch diameter, preformed, 18 x 7 non-rotating, improved plow-steel, fiber-core wire rope |
| Span | 225 to 445 feet (for 150- to 400-foot wide runways) |
| Aircraft engagement Configuration | Bidirectional |
| Off-center engaging limit | 50 feet for up to 225-foot span |
| Runout | 1,000 feet |
| Cycletime | 80 seconds (minimum) |

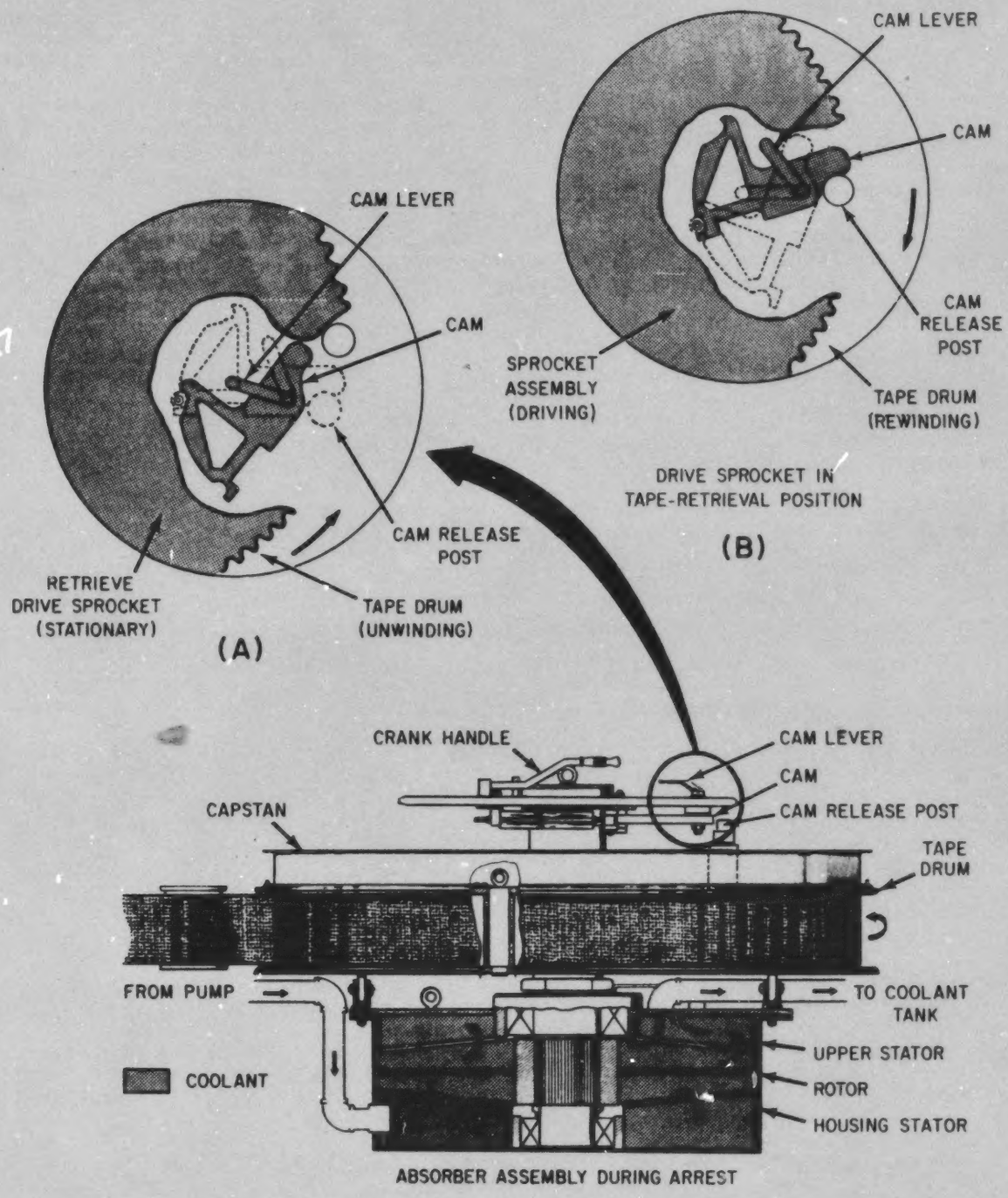


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Figure 5-19.—Absorber assembly.

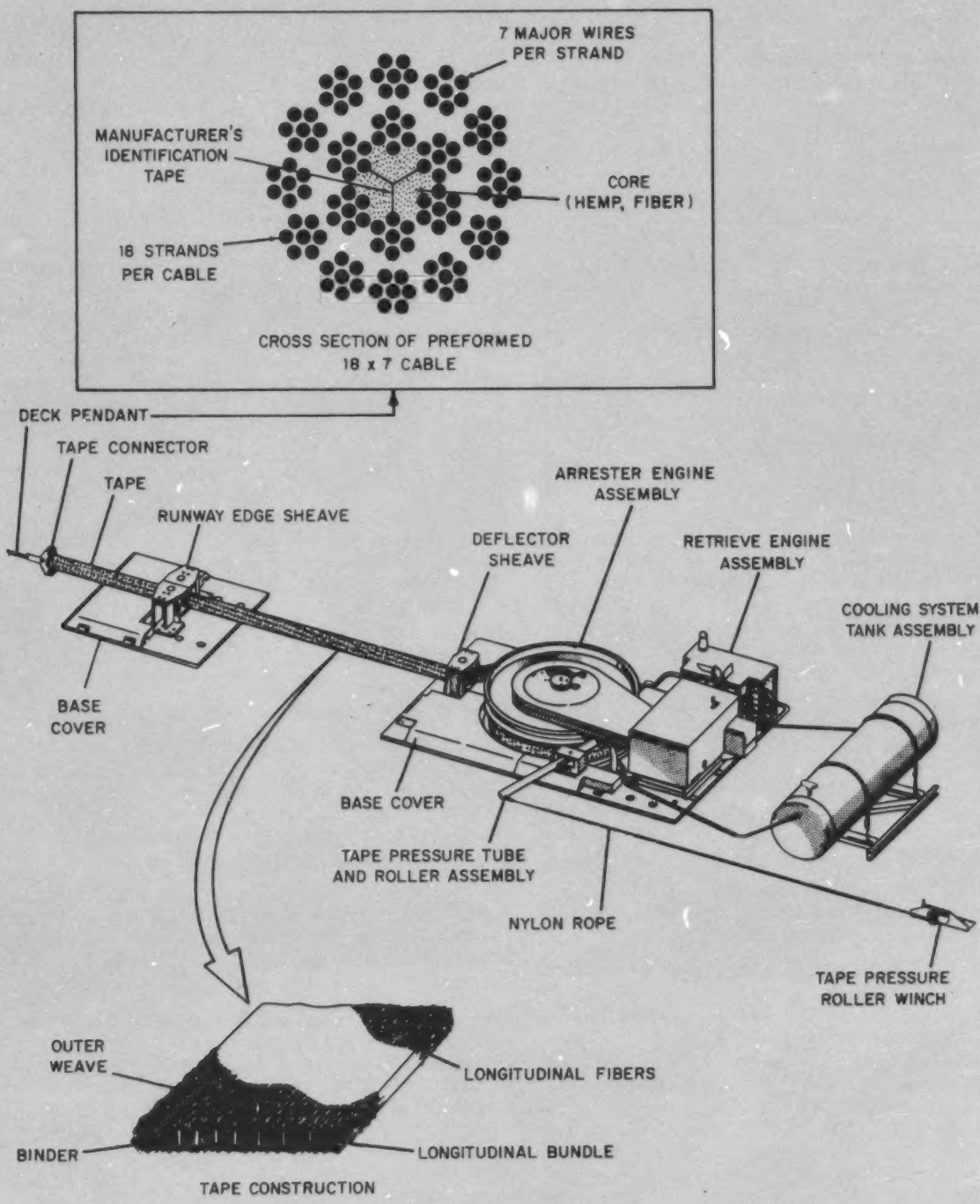


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Figure 5-20.—Arresting engine.

Arrester Engine

The major components of the arrester engine are a tape drum and capstan assembly, a retrieve drive sprocket and bearing assembly, and a vaned rotor mounted on a common shaft assembled in a vaned housing. This energy absorber unit is mounted on a steel base on which are also mounted a retrieve engine, an arrester sheave, and a tape pressure arm pivot.

When the splined tape drum and splined rotor are assembled on the shaft, they function as a unit. The shaft rides in self-aligning roller bearings. The lower bearing is mounted in the absorber housing, and the upper bearing is mounted in the cover. During an arrestment the tape drum drives the rotor whose motion is resisted by the fluid in the housing, thus decelerating the tape drum.

A retrieve drive sprocket assembly is bearing-mounted on the shaft, above the tape drum. At the beginning of an arrestment, the retrieve system is automatically disengaged from the tape drum through the action of the cam release post acting against the automatic release mechanism which is spring-loaded, when armed, to trip when tape tension is nominally 5,000 pounds. This allows the tape drum and rotor to run free of the sprocket assembly. Following arrestment, the retrieve system is manually engaged to the tape drum through contact of the armed, spring-loaded cam and the cam release post. The sprocket is chain-driven by the gasoline engine which is the power source for rewinding the tape onto the tape drum.

Retrieve System Assembly

The retrieve system (fig. 5-21) consists of a gasoline engine with a 24-volt electrical starting system, a torque converter with a front disconnect clutch, and a speed reducer with a duo-cam clutch, operated from a control panel mounted on the retrieve system assembly base. The function of the retrieve assembly is to rewind the tape and pretension the pendant after each arrestment. The output shaft of the gasoline engine and input shaft of the torque converter are directly engaged by manually positioning the clutch handle. The output shaft of the torque converter is coupled to the speed reducer input by a universal joint. A sprocket keyed to the vertical output shaft of the speed reducer is connected by a roller chain to the ball bearing mounted sprocket on the absorber unit. On the extension of the speed reducer input shaft is a one-way clutch which allows the engine to retrieve and pretension the tape, through the system, to the stall load of the torque converter. The torque produced by the converter at stall load provides the proper pretension to the pendant. When the engine throttle on the control panel is pushed in to the idle position, or the stop button is depressed to stop the engine, the duo-cam clutch holds the applied torque, thus maintaining the tension applied to the runway pendant. The entire retrieve assembly is mounted on a base pivoted about one corner and moved by a jackscrew or positioning cam to provide chain takeup.

All controls for operation of the retrieve system are located on a single panel (fig. 5-21) located immediately in front of the clutch handle. To assist starting, the choke is located next to the starter button near the mounted pull-out throttle. A spring-loaded, normally open stop button is used to short the magneto to stop the engine. An engine speed tachometer, oil pressure gage, and ammeter are also mounted on the panel.

Accessory Equipment

In addition to the arrester and retrieve engines, each arresting gear installation includes deflector sheaves, runway edge sheaves, deck pendants, tape connectors, cooling system, tape pressure rollers, and associated hardware.

The sheaves serve as guides for the nylon tapes. The runway edge sheaves are installed at the runway edge. The deflector sheave is adjacent to the tape drum and mounted on the arrester engine base.

The deck pendant is a 1 1/4-inch diameter nonrotating wire rope held above the runway by pendant supports. During arrestment, the aircraft arresting hook engages the deck pendant, causing the tapes to pay out and activate the arresting engines. Their length will vary according to the width of the runway.

Tape connectors are used for coupling the nylon tape to the deck pendant.

Located near each arresting engine is a fluid supply tank for the cooling system. The tank is connected by hoses to the absorber

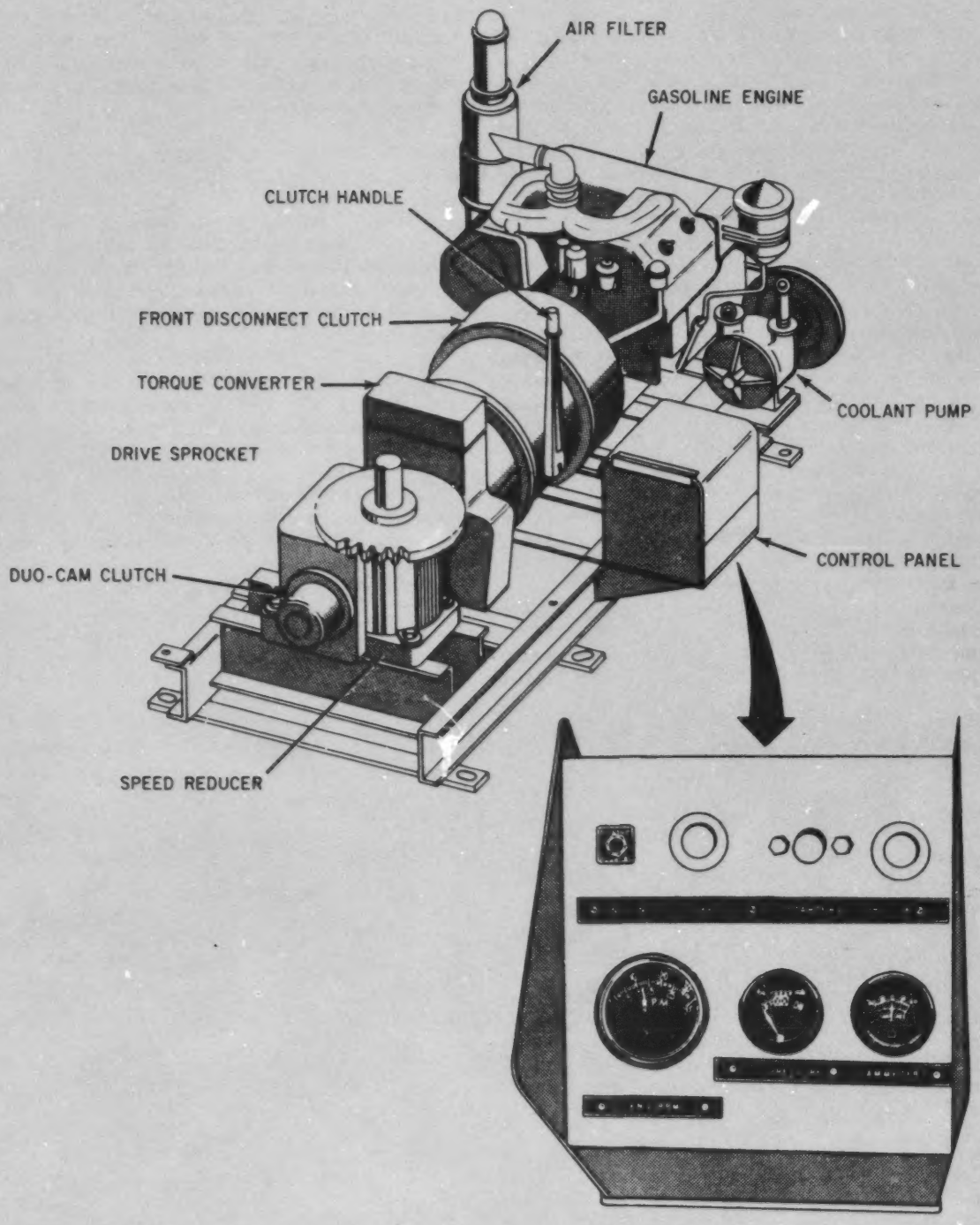


Figure 5-21.—Retrieve assembly and control panel.

housing through a pump mounted on and driven by the retrieve engine. When the retrieve engine is running, the positive displacement pump moves fluid from the tank through the line strainer and check valve into the energy absorber, forcing the heated fluid in the absorber to flow through the outlet to the top of the cooling tank. The large, exposed surface of the tank serves as a heat exchanger, dissipating excess heat to the surrounding air.

The tape pressure roller is used to ensure an even, tight wrapping of tape on the drum during retrieve, and also to prevent overspin during arrestment. The roller is mounted on an arm pivoted in a bracket secured to the arresting engine base. The arm is tensioned by a spring and cable pulled taut by a hand winch.

Covers are provided in those areas where exposed ends of the arrester engine or runway edge sheave holddown bolts might damage the tape while reeving or during operations.

The energy absorber assembly, deflector sheave assembly, pressure roller assembly, and retrieve assembly are mounted on a common base. The runway edge sheave and pressure roller winch have individual bases. All bases are provided with holes for concrete foundation bolts.

## DECK PENDANT SUPPORTS INSTALLATION AND USE

When installing donut wire supports (fig. 5-22) on installed deck pendants, remove pretension from the deck pendant, pull out a few feet of tape, disconnect the tape connector from the pendant terminal and proceed as follows:

1. Place the donut wire support installation tool (fig. 5-23) beneath the pendant terminal and pin the tapered cone to the terminal.
2. Apply grease, specification MIL-G-7711A, to the inside wall of the 1 1/4-inch diameter hole of the donut wire support, the tapered cone, and the pendant terminal.
3. Install the donut wire support on the tapered cone, and pin the cone to the installation tool as shown in figure 5-23.

| Runway Width | Number of Supports Required |
|---|---|
| 150 Ft. | 8 |
| 200 Ft. | 10 |
| 250 Ft. | 12 |
| 300 Ft. | 14 |
| 400 Ft. | 16 |

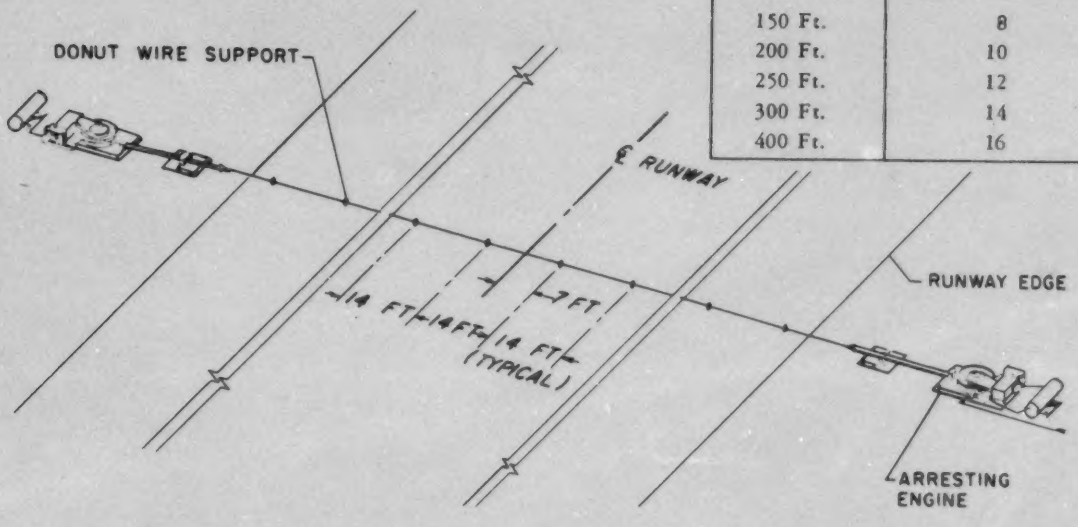


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Figure 5-22.—Donut wire support installation.

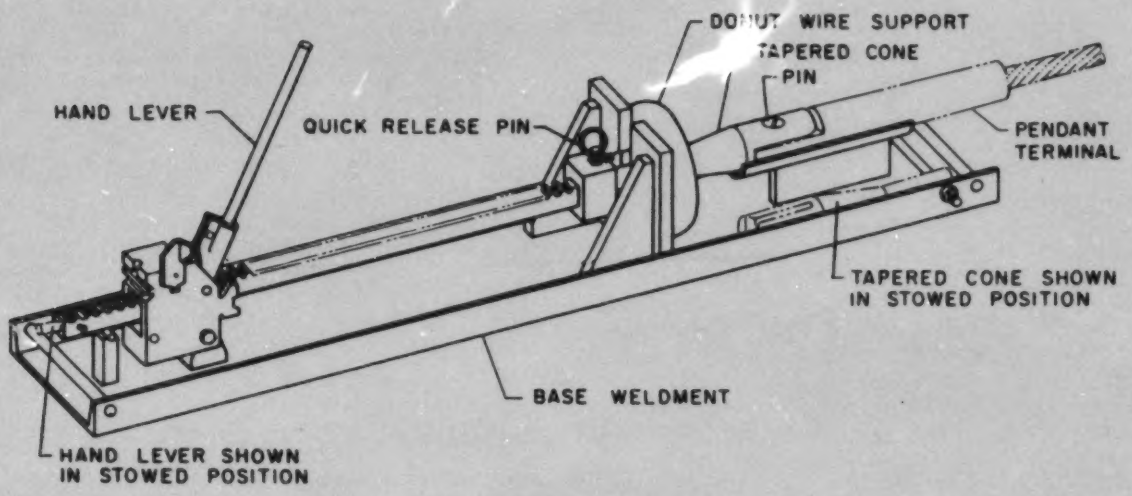


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Figure 5-23.—Donut wire support installation tool.

4. Using the hand lever, inserted in the ratchet, jack the tapered cone and the pendant terminal through the 1 1/4-inch diameter hole in the donut wire support utilizing the full stroke of the rack.

5. Repeat steps 2 through 4 for each donut wire support required.

6. In order to reduce the length of cable over which the donut wire support must be turned, install one-half of the required number of wire supports over each terminal in accordance with the above procedures.

7. Space the donut wire supports by turning each support in the direction of the pendant's helix.

CAUTION: Pushing the donut wire support along the pendant without turning may reduce the ability of the support to retain its position on the pendant.

8. Pretension the deck pendant and check the minimum deck pendant height in accordance with paragraph 2-7 of NAVAIR 51-5-31.

9. After the original donut wire support installation has been approved, paint marks on the runway at the support locations. This will expedite repositioning the supports, if necessary, following an arrestment.

NOTE: Installation of donuts on one or more spare deck pendants is recommended in order to provide a capability for immediate pendant replacement when required.

MINIMUM DECK PENDANT HEIGHT.—To determine that the minimum deck cable height limit has not been exceeded, check the deck pendant as follows:

1. Check for minimum cable clearance of 2 inches between the deck and bottom of the pendant cable at the middle or lowest point between adjacent wire supports. (See fig. 5-7(B)).

2. Using the deck cable height gage, slide the gage from side to side (about 18 inches to either side of the midpoint) to check minimum clearance. Clean the midspan area under the cable, as necessary, to allow smooth side-to-side sliding of the gage.

3. If the gage is easily passed beneath the cable, with no apparent lifting of the cable, minimum cable height limit of 2 inches has not been exceeded.

NOTE: Gage measurements taken under the cable in the engagement zone should discount locally deformed areas of the cable, such as jogs or spirals, caused by hook impact. However, kinked cables must not be allowed to remain in service.

Table 5-3. – Functional Inspection Chart

| Interval | Part | Inspect for | Action to be taken |
|---|---|---|---|
| During Pullout. | Arresting engine. | Alignment. | Align and secure. |
| | | Rigidity and anchorage. | Repair and/or secure anchor bolts. |
| | | Leakage. | Tighten joints or packings. |
| | Tape drum. | Binding. | Adjust clearance between drum and support rollers to 1/16 inch minimum and 1/8 inch maximum when tape drum is full. |
| | Deflector sheave and | Freedom of rotation. | Refer to paragraphs 8-59 and 8-62.* |
| | Runway edge sheaves. | Security. | Secure mountings. |
| | | Deformation. | Replace as required. |
| | | Alignment. | Align. |
| | Tow vehicle dynamometer. | Maintain close observation of load required to overcome arresting engine inertia and maintain motion versus tape payout. | Record loads at payout distances of 100, 200 and 300 feet from runway edge sheaves. |
| After pullout, and prior to retrieve. | Tapes. | Wear, cuts, abrasions, tape life, condition of GACO coating. | Refer to paragraph 8-43.* Repair GACO coating as required. |
| | | Security to hub. | Tighten tape pin retainer bolts. Check pin and replace if damaged or corroded. |
| During retrieve | Tapes. | Erratic retrieve and tape travel. | Personnel not operating equipment correctly. |
| | | Twists when being rewound. | Disconnect pendant and tape connector and remove twist. |
| | | Even tight wrap. | Adjust rope tension on pressure roller arm. |
| | Tape drums. | Binding. | Adjust clearance between drum and support rollers to 1/16 inch minimum and 1/8 inch maximum. |
| During retrieve (Cont'd) | Retrieve engine. | Smoothness of operation. | Adjust carburetor. |
| | | Unusual noise. | Isolate and adjust or lubricate as required. |
| | | Pump Leakage. | Tighten packing nuts. |
| After retrieve | Deck pendant. | Height above runway. | Refer to paragraph 2-7.* |
| | | Damage or deformation of cable. | Replace in accordance with wire rope replacement criteria. Refer to paragraph 8-51.* |
| | Tapes. | Wear, cuts, abrasions and condition of GACO coating. | Refer to paragraph 8-43. Repair GACO coating as required.* |
| | Tape guides. | Wear, abrasions and gouges. | Grind smooth, remove sharp edges and blend in deep gouges. |

*Current edition of NAVWEPS 51-5-28.

4. If the deck cable height gage does not clear the cable, increase pendant tension through the retrieve engine adjustment. Recheck pendant height.

INSPECTION

A functional inspection of the arresting gear equipment must be performed every 30 days. This inspection consists of operating the equipment through a complete cycle. The complete installation is inspected for stability; every visible moving part is inspected for security, freedom of motion, quiet operation, and alignment. The diligent performance of this inspection, plus the accomplishment of necessary corrective maintenance, will reduce malfunctions and inoperative time and help assure the safety of the men operating the equipment. Table 5-3 lists the inspections and corrective actions.

MAINTENANCE

Tapes

The tape is essentially a woven nylon belt consisting of an outer weave and longitudinal fibers which are the primary load-bearing members, and the tape is so constructed that the fibers are secured in series of bundles of longitudinal fibers with longitudinal binders between bundles. (See fig. 5-20.)

INSPECTION.—The wear on individual tapes, as a result of runway abrasion, will vary considerably depending upon the exact condition of the runway surface. Inspection of the entire length of pulled out tape shall be made after each arrestment before retraction, during functional inspection in accordance with table 5-3, and during any other pullout. Those exposed sections of the tape in the vicinity of the tape connectors shall be examined with extreme care daily, prior to each day's operations, and after each arrestment, if time permits, as follows:

1. Visually inspect the tape for any evidence of cuts, abrasions, or wear.
2. Examine the log to determine the number of engagements to which the tape has been subjected.
3. Examine the log to determine the number of months the tape has been in service.

REPLACEMENT CRITERIA.—No attempt should be made to repair the tape. Replace the tape after 100 arrestments, or as soon as any of the following conditions exist:

1. Tape has been cut through outer weave into the longitudinal (load-carrying) members with a cut larger than 1/2 inch.
2. Tape is split longitudinally.
3. If, at any point beyond 60 feet from the pendant tape connector assembly, the tape is worn more than 1/2 inch on either side, or tape width is less than 7 1/4 inches.
4. Sewed loop has five or more complete transverse rows of failed stitching.

NOTE: Coat worn areas on faces and edges of tape with Nylon Tape Coating (GACO) before the wear reaches the longitudinal load-carrying members. This will extend the service life of the tape and permit use to attain 100 arrestments. Care must be taken that the only protective coating applied to nylon arresting gear tape is Nylon Tape Coating NAVAIRENGCEN P/N 323965-1, -5 or -55. Only thinner and cleaner, NAVAIRENGCEN P/N 323968-1, shall be used with the above coating to thin it, if necessary. It may also be used to clean objects accidentally coated.

5. The tape has areas of surface abrasion where the outer casing has worn through, exposing the longitudinal yarns. The next two paragraphs are the limits of wear:

| Length (along tape) | x | Width (across tape) | = | Max. Total Area (Approx.) |
|---|---|---|---|---|
| 1 in. | x | 2 in. | = | 2 sq. in. |
| 2 in. | x | 1 in. | = | 2 sq. in. |
| 1 1/4 in. | x | 1 5/8 in. | = | 2 sq. in. |

i.e., the critical exposed area is two (2) square inches.

Worn areas are too numerous or wear is too rapid to allow coating with GACO before the wear reaches the longitudinal load-carrying members of the tape.

SERVICE LIFE EXTENSION.—E-28 arresting gear purchase tape which has been in service for twelve months and does not exceed the criteria of the following paragraphs is

eligible for a service life extension in accordance with the following procedure.

1. 0 to 49 arrestments.

a. Tape service life is automatically extended to 15 months with a limit of 50 arrestments, provided all other criteria of this and following paragraphs are not exceeded.

b. If 50 total arrestments are attained during the three additional months, proceed as outlined in paragraphs 2a and 2b below.

c. If 50 total arrestments are not attained near the completion of the three additional months, proceed as outlined in paragraph 2b.

2. 50 to 99 arrestments.

a. Remove tape from arresting engine and hold for further instructions from NAVAIRENGCEN.

b. Notify NAVAIRENGCEN, giving tape serial number, contract number, date installed, and the tape history relative to type of aircraft arrested, aircraft weight, and aircraft engaging velocity.

REVERSAL.—The tape must be reversed if the following conditions occur before 100 arrestments:

1. If, at any point within 60 feet from the tape connector, the tape is worn more than 1/2 inch on either side, or tape width is less than 7 1/4 inches.

2. Served loop has no more than four complete transverse rows of failed stitching.

CAUTION: Purchase tapes that are worn and coated with GACO should not be reversed for 425-foot deck span installations.

Donut Wire Supports

INSPECTION.—The wear on individual wire supports, as a result of runway abrasion, will vary considerably depending upon exact conditions of the runway surface. The supports may shift from their initial positions under heavy deck traffic conditions, and occasional respacing will be required. Some donuts may fail and become detached from the deck pendant during high speed engagements. Donut wire supports shall be subjected to a thorough visual inspection after each engagement for the following conditions:

1. Excessive wear.
2. Radial cracks.
3. Correct spacing of supports.
4. Loss of support.

REPLACEMENT CRITERIA.—If any donut wire support becomes unserviceable, it shall be removed from the deck pendant by cutting it free. Replace the donut wire support in accordance with paragraph 2-6 of NAVAIR 51-5-31, and respace the supports. Supports shall be replaced as soon as any of the following conditions exist:

1. Support has radial cracks of 1 inch or longer.

2. Minimum deck pendant height (see paragraph 2-7 of NAVAIR 51-5-31) cannot be attained due to excessive wear of the support.

Deck Pendants

The cable used on the deck pendant of the E-28 Arresting Gear is a 1 1/4-inch diameter preformed, 18 x 7 nonrotating, improved plow steel, fiber core wire rope, specification RR-W-410A. The wire rope consists of one core and 18 strands of 7 wires each, giving a total number of 126 wires in the rope. The inner layer consists of 6 strands of 7 wires each and is lang lay, left lay; and the other layer consists of 12 strands of 7 wires each and is regular lay, right lay.

A definition of the terms used in describing wire rope damage and deformation is contained in the following:

1. Kinking. Retraction sometimes causes formation of large, loose helical loops in the pendant. Such loops are usually eliminated as tension increases on the pendant. Occasionally a loop, instead of being eliminated, tightens into a small loop called a kink. Kinks can also form if the retraction cycle is halted abruptly, if retraction is not a smooth continuous operation, or if torque is allowed to build up in the cable.

2. Pulled-through kink. It is possible for a kink to form and then pull through during retraction, although this may go unnoticed.

Inspection of the cable will reveal one or all of the following conditions:

a. Bird caging—opening of the cable strands.
b. Strand distortion—unlaying of cable strands from the normal cable lay.
c. Severe extrusion of the core.
d. Wire distortion—unlaying of wires from normal lay.
e. Sharp deviation of cable axis from a straight line.

3. Broken wires. Broken wires can occur at any point on the deck pendant. Hemp core pushing out between wire strands could be an indication of broken wires.

NOTE: A quick, easy method to ascertain the existence of broken wires is to run gloved hands (cotton work gloves) lightly back and forth over the pendant. The gloves will instantly catch onto the ends of the broken wires.

4. Excessive wear. A pendant is considered excessively worn when there are 30 or more flat spots 1/2 inch or more in length in one complete strand for one cable pitch length. This flattening of the wire crowns is caused by abrasion as the deck pendant contacts the runway.

INSPECTION.—Deck pendants shall be subjected to a thorough visual inspection:

1. After each landing.
2. Daily, prior to each day's operations, and if possible, prior to an arrestment.

Visually inspect pendant for the following conditions:

1. Kinking.
2. Evidence of pull-through kink.
3. Broken wires.
4. Excessive wear.
5. Loss of preservative.
6. Check log to determine the number of months the deck pendant has been in service and number of arrestments made.

REPLACEMENT CRITERIA.—Causes for immediate replacement of the deck pendant are as follows:

1. Fifteen arrestments.

NOTE: Each engagement at speeds between 150 and 160 knots counts as 1 1/2 arrestments toward the total of 15.

2. Engaging speed exceeding 160 knots.
3. Kinking.
4. Nine broken wires over entire length of pendant.
5. Five or more broken wires within one cable pitch length.
6. Hemp core visible.
7. Strand distortion.
8. Bird caging.
9. Excessive wear.
10. Installed for a period of six months, regardless of condition.
11. Uncrated and exposed for a period of eight months.

Arresting Gear Hydraulic Fluid.—Prior to filling or replenishing the hydraulic fluid in the arresting gear system, the arresting gear maintenance officer or his designated representative shall determine the acceptability of the hydraulic fluid by accomplishing the following inspection:

1. Visually inspect the markings of each individual container to be used to ensure the following are listed:

a. Nomenclature—Hydraulic Fluid-Arresting Gear.
b. Specification—MIL-H-5559A.
c. NAEC Part No. 91782-5, NSN 9150-00-224-8729 (5-gal. can).
NAEC Part No. 91782-55, NSN 9150-00-243-1987 (55-gal. drum).

NOTE: If any marking is incorrect, the contents of the container shall not be used. Either obtain verification of the contents from the supply officer or submit a sample for analysis as in paragraph 3 below. Do not accept any unsealed arresting gear hydraulic fluid container from supply.

2. After verification of the containers' markings, open each container, withdraw a sample of fluid, and visually inspect for color and contamination.
3. If the fluid is colorless and free of contaminants, smell the sample. The sample should be odorless.

After an acceptable hydraulic fluid container has been emptied, obliterate all printed markings on the drum or destroy the container.

If any of the checks made in the above paragraph show that the fluid might not be acceptable, notify your type command and forward a sample of the fluid to the nearest naval testing facility for analysis. Make a record of all data on the container for possible future location of source of supply.

Arresting gear maintenance criteria requires the changing of the fluid mixture on an 18-month basis. This change is to be accomplished in accordance with the instructions listed as follows:

NOTE: An optional pre-mixed Antifreeze, Arctic-type MIL-A-11755, NSN 9G-6850-00-174-1806, may be used in place of the above if desired. E-28 installations desiring to change to the pre-mixed antifreeze shall continue to use the present fluid mixture until it is time for the required 18-month fluid change. The cooling system tank, the energy absorber housing, and all hydraulic lines shall then be flushed, and the system refilled with Antifreeze, Arctic-type MIL-A-11755. (See fig. 5-24.)

1. Disconnect hose assembly at pump inlet, place in a suitable container, and drain the tank.

NOTE: Do not confuse this hose with the line connected between the strainer and the check valve.

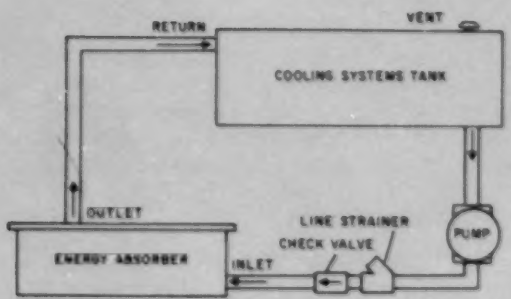


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Figure 5-24.—Cooling system.

2. Flush tank with clean water.
3. Remove hose assembly from absorber outlet and tank inlet.
4. Disconnect pipe at absorber inlet and place in a suitable container.
5. Connect hose assembly removed in step 3 to absorber inlet and pump inlet.
6. Start gasoline engine and proceed to pump fluid from the absorber housing. During this operation, continually flush the housing by pouring clean water into the absorber outlet until all traces of fluid are gone.
7. Clean fluid strainer.
8. Reconnect piping as originally installed.
9. Idle engine and fill the system with a fresh coolant mixture consisting (by volume) of 2 parts arresting gear hydraulic fluid, and 1 part distilled water.

## LANDING LOG

After each arrested landing, arrestment data shall be recorded in a landing log. This log shall contain pertinent information on all arrested landings and/or aborted takeoffs that are arresting gear-assisted.

The log shall have the 19 columns (see fig. 5-25A) as in the Quarterly Runway Arresting Engagement Report, plus any additional columns desired by the command.

Quarterly Runway Arresting Gear Engagement Report.—Detailed information as taken from the landing log pertinent to each engagement must be recorded on the Quarterly Runway Arresting Gear Engagement Report, NAVWEPS Form 13810/3(3-63). The reverse side of this form (fig. 5-25 (B)) contains instructions for properly recording the desired information.

The completed form must be forwarded to NAVAIRSYSCOM with copies sent to NAVAIRENGCEN, NAEC (SE-7), and NAVAVNSAFECEN.

## TORQUE WRENCH

For engineering reasons almost every nut and bolt encountered by the ABH on the E-28 arresting gear must be tightened to an exact pressure. In these cases a torque wrench must be used. The torque wrench is a precision tool consisting of a torque-indicating handle and

appropriate adapter or attachments. It measures the amount of turning or twisting force applied to a nut or bolt in inch- or foot-pounds.

Most machinery is assembled with close clearances, and the piping that is to sustain high pressures must be connected carefully; therefore, it is important that the correct amount of pressure be applied to the nuts and bolts that hold the various parts together. Applicable catapult and arresting gear bulletins specify the amount of torque that is to be applied. The torque wrench (when properly used) enables the user to determine when these specifications have been met.

The most commonly used torque wrenches are the deflecting beam, dial indicating, and micrometer setting types. (See fig. 5-26.)

When the deflecting beam and the dial indicating torque wrenches are used, the torque is read visually on a dial or scale mounted on the handle of the wrench.

To use the micrometer setting type, unlock the grip and adjust the handle to the desired setting on the micrometer scale, then relock the grip. Install the required socket or adapter to the square drive of the handle. Place the wrench assembly on the nut or bolt and pull in a clockwise direction with a smooth, steady motion.

CAUTION: A fast or jerky motion will result in an improperly torqued unit.

When the torque value is reached (indicated on the handle setting), the handle will automatically release and move freely for a short distance. The release and free travel is easily felt, so there is no doubt about when the torquing process is complete.

To assure getting the correct amount of torque on the nuts and bolts, all torque handles must be tested at least once a month, or more often if usage indicates it is necessary.

The following precautions should be observed when using torque wrenches:

1. Do not use the wrench as a hammer.
2. Do not use the wrench to apply greater amounts of torque than its rated capacity.
3. Do not use the wrench to break loose bolts or nuts which have been previously tightened.
4. When using the micrometer setting type, do not move the setting handle below the lowest torque setting. However, it should be placed at its lowest setting prior to returning to stowage.
5. Never stow a torque wrench in a toolbox or in an area where it may be damaged.

The accuracy of torque measuring depends a lot on the cleanliness of the threads, how accurately they are cut, the type and amount of lubrication applied to the threads, and the method of supporting the wrench during the tightening operation. Inspect and make sure these things are complied with in order to get the most accurate torque reading possible.

## DYNAMOMETER

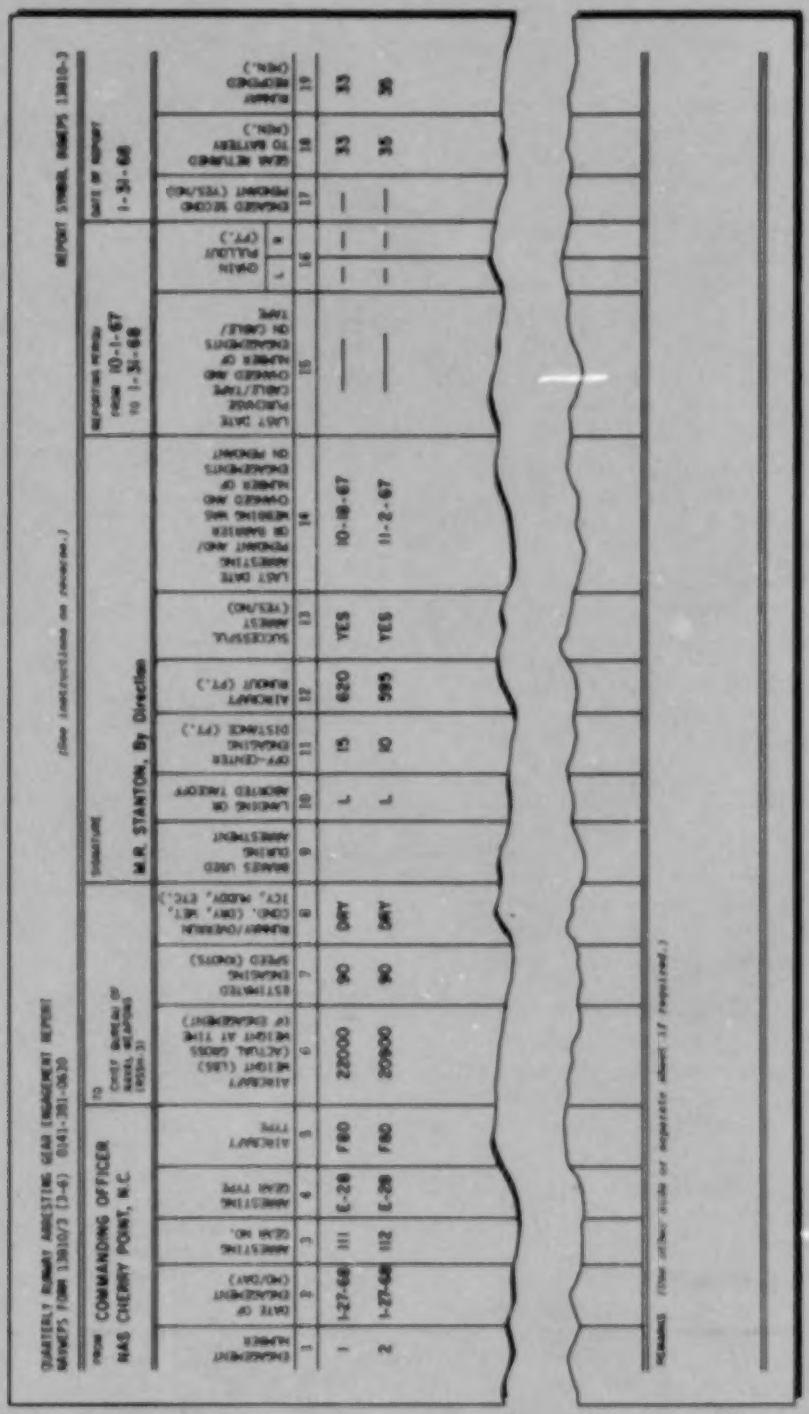
A dynamometer is an apparatus for measuring force or energy. It commonly embodies a spring to be compressed, combined with an index (scale) to show the amount of tension obtained. Figure 5-27 illustrates a common type of dynamometer.

When a hydrostatic test is performed on arresting gear engines, a dynamometer is connected between the tape connector and a tractor capable of pulling 8,000 pounds. The tape is pulled out perpendicular to the centerline of the runway until the retract cam is disarmed. If the observed reading is 5,500 $^{+500}_{-200}$ pounds, cam pretensioning is properly adjusted. (See NAVAIR 51-5-31.)

## CHAIN RATCHETS

One piece of equipment the ABH should be familiar with is the chain ratchet. In more common terms it is usually referred to as a "come-along". (See fig. 5-28.)

Chain ratchets have an operating handle similar to a ratchet wrench, hence its name. They are normally light in weight and come in a variety of sizes, depending on the job to be done. A chain ratchet has a friction brake incorporated in its mechanism to hold the load when the handle is released. Chain ratchets are reversible so that the load may be raised, inspected, and lowered back into place.



QUARTERLY RUNWAY ARRESTING GEAR ENGAGEMENT REPORT
NAVAIR 13810-3 (3-67) (Use instructions on reverse.)

FROM: COMMANDING OFFICER, NAS CHERRY POINT, N.C.
TO: CHIEF BUREAU OF NAVAL WEAPONS (RSSH-3)
SIGNATURE: M.R. STANTON, By Direction
REPORTING PERIOD: FROM 10-1-67 TO 1-31-68
DATE OF REPORT: 1-31-68

| ENGAGEMENT NUMBER | DATE OF ENGAGEMENT (MO/DAY) | ARRESTING GEAR NO. | ARRESTING GEAR TYPE | AIRCRAFT TYPE | AIRCRAFT WEIGHT (LBS) (ACTUAL GROSS WEIGHT AT TIME OF ENGAGEMENT) | ESTIMATED ENGAGING SPEED (KNOTS) | RUNWAY/ORIENTATION (END, (DRY, WET, ICY, MUDDY, ETC.) | BOARDS USED DURING ARRESTMENT | LANDING OR ARRESTED TAKEOFF | OFF-CENTER ENGAGING DISTANCE (FT.) | AIRCRAFT RUDDER (FT.) | SUCCESSFUL ARREST (YES/NO) | LAST DATE ARRESTING AND/OR TENSION OR BARRIER WAS REMOVED AND OVERED AND NUMBER OF ENGAGEMENTS ON RECORD | LAST DATE PULLOUT CABLE/TAPE OVERED AND NUMBER OF ENGAGEMENTS ON CABLE/TAPE | CHAIN PULLOUT (FT.) | CHAIN PULLOUT (FT.) | ENGAGED HOOKS REQUIRED REPLACEMENT (YES/NO) | GEAR RETURNED TO BATTERY (MIN.) | RUNWAY REOPENED (MIN.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | | 17 | 18 | 19 |
| 1 | 1-27-68 | 111 | E-28 | F8D | 22000 | 90 | DRY | | L | 15 | 620 | YES | 10-18-67 | | — | — | — | 33 | 33 |
| 2 | 1-27-68 | 112 | E-28 | F8D | 20900 | 90 | DRY | | L | 10 | 595 | YES | 11-2-67 | | — | — | — | 35 | 35 |

REMARKS (Use other side or separate sheet if required.)

200.43

Figure 5-28(A).—Quarterly Runway Arresting Gear Engagement Report (Sheet 1 of 2).

INSTRUCTIONS

*Send original to BUWEPS. Send one copy each to OPNAV (Op-05F3; NAVAIRENGCEN (NAELEHKSE-71); NAVAVNSAFECEN.*

Columns 2, 6, 7, 8, 14, and 15 are self-explanatory.

Column 1 - Engagement Number. Insert the number of engagements occurring at the activity, starting with first engagement of applicable calendar year.

Column 3 - Arresting Gear Number. Identify the particular arresting gear engaged. Use the number assigned on Sketch of Arresting Gear Location and Arrangement.

Column 4 - Arresting Gear Type. Indicate type designation, i.e., E-5, E-5-1, MA-1A, E-6, E-14, E-15, E-16, E-27 or M-2.

Column 5 - Aircraft Type. Use official Department of Defense aircraft designation, i.e., F-4B (F400-1), A-5A (A3J-1), F-8C (F8U2), etc.

Column 9 - Broken Used During Arrestment. Indicate "INOP" for Inoperative, "I" for Intermittent, "C" for Constant, and "NO" for Not Applied.

Column 10 - Landing or Aborted Takeoff. Indicate with "L" or "A" respectively, whether engagement was made during a landing or after an aborted takeoff.

Column 11 - Off-Center Engaging Distance. Specify distance in feet from the centerline of the runway to the point of engagement.

Column 12 - Aircraft Runout. Specify distance in feet from point of engagement to point where aircraft hook point stopped. For pendant failures, give distance from point of engagement to approximate position of aircraft hook point at time of failure.

Column 13 - Successful Arrest (Yes/Not. Answer "Yes" if aircraft is stopped within the station boundary as a result of the arresting gear engagement with minor or no injury to the occupants.

Column 16 - Chain Pullout. Give total length in feet of chain moved on both sides of the runway. Chain pullout is the length of the chain displaced, pulled out, or doubled back during an engagement.

Column 17 - Engaged Second Pendant. For arresting gear having two pendants, such as arresting gear, for example, indicate "Yes" or "No."

Column 18 - Gear Returned to Battery. Indicate time in minutes from moment retraction began until gear was again ready to accept aircraft.

Column 19 - Runway Reopened. Show time in minutes from arrestment to time runway reopened to aircraft traffic.

Remarks. Information amplifying or supplementing data required in the table is desired in the following categories:

1. General. Amplification of information reported in specific columns to be submitted by all stations.

a. (Refer to Column 10 - Landing or Aborted Takeoff) Provide information on type of aircraft emergency, i.e., hydraulic failure, engine failure, blown tire, etc., or indicate inadvertent if arrestment was unintentional.

b. (Refer to Column 12 - Aircraft Runout) Provide circumstances of "wrong way" engagement of a one-directional system.

c. (Refer to Column 13 - Successful Arrest (Yes/No)) If "Yes" or "No" and aircraft is damaged, indicate category or class of aircraft damage. To ensure more reliable equipment for shorebased arresting gear, component failures or replacement of parts (other than normal high attrition items) due to unsatisfactory condition shall be reported in accordance with BUWEPSINST 4700.2. The number assigned to the reporting FUR should be supplied. Indicate point of tailhook to arrest the aircraft wherein the hook skipped or missed the wire (Bolter).

d. (Refer to Column 18 - Gear Returned to Battery) Provide comments on station's operational procedures which have facilitated more rapid rebattery of the gear and which may be passed on to other stations.

2. Specific. Supplementary information pertaining to certain types of arresting gear to be submitted by user stations.

a. E-5/E-5-1/MA-1A - Report significant chain wear. Advise quantities (size and lengths) approaching wear criteria limits established by current service bulletins.

b. E-14/E-14-1 - Provide data, number of engagements attained, and indicate whether left or right cush unit the vessel is changed. Report instances where components appear to require unusually more frequent replacement. Provide number of retrieves accomplished and length of time in service for each retrieve rope considered no longer usable.

c. E-15/E-27 - Provide data and number of engagements attained for each brake replacement. When the purchase tape is permanently replaced, indicate cause, i.e., wear, tear, damage, failure. Report the date, total number of engagements attained and whether left or right cush unit a tape connective is replaced.

NAVMCPS FORM 13810/3 (3-6) (BACK)

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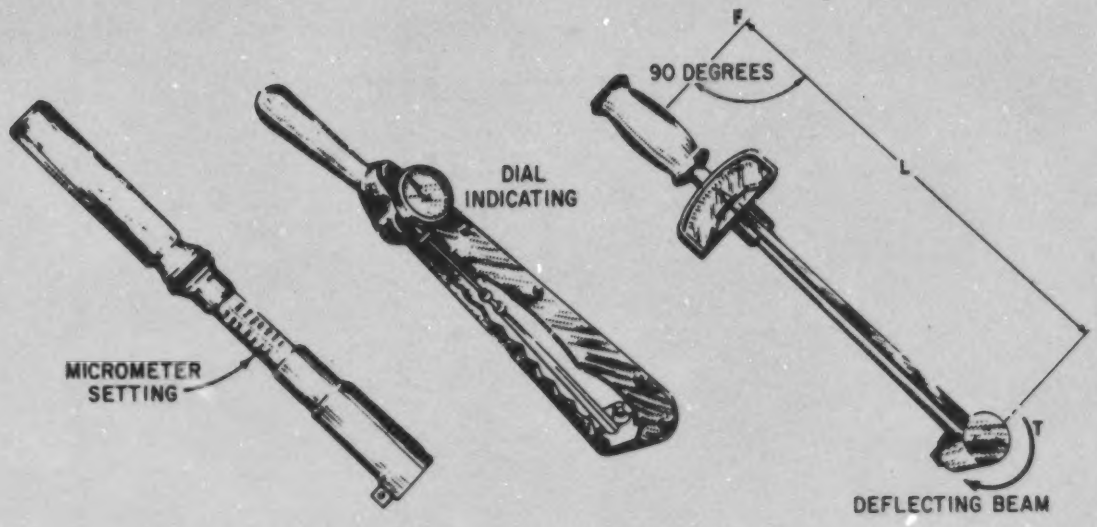
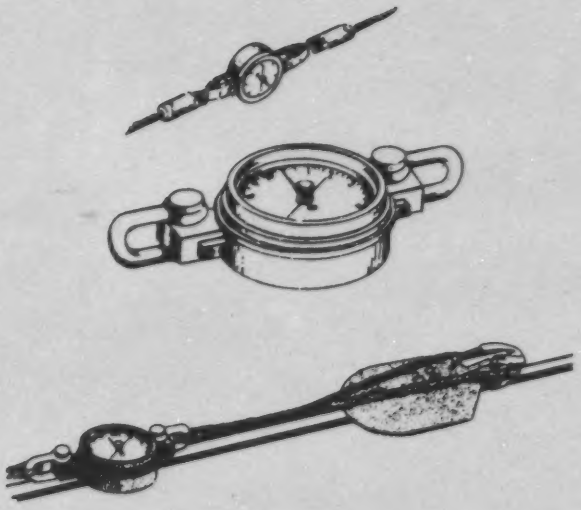
**Figure 5-25(B).—Quarterly Runway Arresting Gear Engagement Report (Sheet 2 of 2).**




195.8

Figure 5-26.—Torque wrenches.



195.9

Figure 5-27.—Dynamometer cable tension check.

195.12

Figure 5-28.—Come-along.

Some of the common types of chain ratchets utilize either sprocket (bicycle) chain or link chain.

Always lubricate a chain ratchet before stowing. Never apply more power than can be exerted by one man. Do not use extensions on the ratchet handle for additional leverage. Inspect chain ratchets regularly to ensure that the chain, hooks, and ratchet gears are in good condition. Never apply a strain greater than the safe working load.



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# CHAPTER 6

# SHIPBOARD FIREFIGHTING

Fire is a constant potential hazard aboard ship. All possible measures must be taken to prevent the occurrence of fire or to bring about its rapid extinguishment. In many cases, fires occur in conjunction with other damage, as a result of enemy action, weather, or accident. Unless fire is rapidly and effectively extinguished, it may easily cause more damage than the initial casualty. In fact, fire may cause the loss of a ship even after the original damage has been repaired or minimized.

As an Aviation Boatswain's Mate, you will need to know a great deal about fire. You will have to know how to identify the different classes of fires, how to extinguish them, and how to use and care for firefighting equipment. You must also have a thorough understanding of the ship's systems that are important in connection with firefighting. The more you learn about fires and firefighting, the more effectively you will be able to contribute to the safety of your ship.

This chapter deals with the fundamentals of firefighting, including the nature of fire, the classification of fires, the fundamentals of extinguishment, and the extinguishing agents used.

## FIRE

### WHAT IS FIRE?

Fire, also called burning or combustion, is a rapid chemical reaction that results in the release of energy in the form of light and noticeable heat. Most combustion involves very rapid OXIDATION—that is, the chemical reaction by which oxygen combines chemically with the elements of the burning substance.

Even when oxidation proceeds very slowly, as in the case of a piece of iron that is rusting, a small amount of heat is generated. However, this heat is usually dissipated before there is any noticeable rise in the temperature of the material being oxidized. With certain types of materials, slow oxidation can turn into fast oxidation (fire) if the heat is not dissipated. When this occurs, we say that SPONTANEOUS COMBUSTION has occurred. Such things as rags or papers soaked with animal or vegetable fats or with paints or solvents are particularly subject to spontaneous combustion if they are stowed in confined spaces where the heat of oxidation cannot be dissipated rapidly enough.

In order to have a combustible fuel or substance take fire, it must have an ignition source and it must be hot enough to burn. The lowest temperature at which a flammable substance gives off vapors that will burn when a flame or spark is applied is called the FLASH POINT. The FIRE POINT, which is usually a few degrees higher than the flash point, is the temperature at which the fuel will continue to burn after it has been ignited. The AUTO-IGNITION or SELF-IGNITION POINT is the lowest temperature to which a substance must be heated to give off vapors that will burn without the application of a spark or flame. In other words, the auto-ignition point is the temperature at which spontaneous combustion occurs. The auto-ignition point is usually at a much higher temperature than the fire point.

The range between the smallest and the largest amounts of vapor in a given quantity of air that will burn or explode when ignited is called the FLAMMABLE RANGE or the EXPLOSIVE RANGE. Say, for example, that a substance has a flammable or explosive range of 1 to 12 percent. This means that fire or explosion can occur if the atmosphere contains more than 1 percent but less than 12 percent of the vapor of this substance. In general, the percentages referred to in

connection with flammable or explosive ranges are percentages by volume.

It should be apparent by now that a fire cannot exist without three things: (1) a combustible material, (2) a sufficiently high temperature, and (3) a supply of oxygen. Because of these three requirements, the process of fire is sometimes regarded as being a triangle with the three sides consisting of FUEL, HEAT, and OXYGEN. As we will see presently, the control and extinguishment of fires is generally brought about by eliminating one side of the fire triangle—that is, by removing fuel, heat, or oxygen.

## CLASSIFICATION OF FIRES

Fires are classified according to the nature of the combustibles (or fuels) involved. The classification of any particular fire is of great importance, since it determines the manner in which the fire must be put out. Fires are classified as being class A, class B, class C, or class D fires.

CLASS A fires are those occurring in such ordinary combustible materials as wood, cloth, paper, upholstery, and similar materials. Class A fires are usually extinguished with water, using high or low velocity fog or solid streams. Class A fires leave embers or ashes, and they must always be overhauled.

CLASS B fires are those occurring in the vapor-air mixture over the surface of flammable liquids such as gasoline, jet-fuels, diesel oil, fuel oil, paints, thinners, solvents, lubricating oils, and greases. Dry chemical, foam, light water, carbon dioxide, or water fog can be used to extinguish class B fires; the choice of agent depends upon the circumstances of the fire.

CLASS C fires are those occurring in electrical equipment. Nonconducting extinguishing agents such as dry chemicals and carbon dioxide are used for extinguishing class C fires. Carbon dioxide is the preferred extinguishing agent because it leaves no residue.

CLASS D fires are those occurring in combustible metals such as magnesium, titanium, and sodium. Special techniques have been developed for the control of this type of fire.

## PRINCIPLES OF EXTINGUISHMENT

In general, fires may be extinguished by removing one side of the fire triangle (fuel, heat, or oxygen) or by slowing down the rate of combustion. The method or methods of extinguishment used in any specific instance depend upon the classification of the fire and the circumstances surrounding the fire.

### Removal of Fuel

Although it is not usually possible to actually remove the fuel in order to control a fire, there may be circumstances in which fuel removal is possible. If part of the fuel that is near or actually in a fire can safely be jettisoned over the side, this should be done as soon as possible. Damage control parties must stand ready at all times to shift combustibles to safe areas and to take whatever measures that are possible to prevent additional fuel from coming into contact with the fire. In particular, supply valves in gasoline and oil lines must be closed immediately.

### Removal of Heat

If enough heat can be removed by cooling the fuel to a temperature below that at which it will support combustion, the fire will go out.

Heat may be transferred in three ways: by radiation, by conduction, and by convection. In the process known as radiation, heat is radiated in all directions; it is radiated heat that causes you to feel hot when you stand near an open fire. In conduction, heat is transferred through a substance or from one substance to another by direct contact from molecule to molecule; thus a thick steel bulkhead with a fire on one side conducts heat from the fire to the adjoining compartments. In convection, the heated air and other gases rising from a fire bring heat to all combustible materials within reach. Heat transfer by convection is a particular danger in the case of ventilation systems, which may carry heated gases to places that are very far removed from the original fire.

To eliminate the heat side of the fire triangle, it is necessary to cool the fire by applying something that will absorb the heat. Although some other materials serve this purpose, water is the most commonly used cooling agent. Water may be applied in the form of a solid stream, as a fog, or incorporated in foam. The way in which the water

or other cooling agent is applied depends upon the nature of the fire.

### Control of Oxygen

The third component of the fire triangle, oxygen, is difficult to control because we obviously cannot remove oxygen from the atmospheric air that normally surrounds a fire. However, oxygen can be diluted or displaced by other substances that are noncombustible, so that extinguishment of the fire will occur.

If fire occurs in a closed space, it can be extinguished by diluting the air with carbon dioxide ($CO_2$) gas. This dilution of the air must proceed to a certain point before the flames are extinguished, but no fire can exist after this point has been reached. In general, a large enough volume of $CO_2$ must be used to reduce the oxygen content to 15 percent or less. The amount of oxygen normally present in air is about 21 percent.

Foam will also keep oxygen from reaching the burning materials, thus smothering the fire.

### Reduction in Rate of Combustion

Dry chemical fire extinguishing agents extinguish fires by a process that is not quite the same as removing one side of the fire triangle. It is believed that these agents achieve their extinguishing effects by interfering with the combustion reaction.

### Importance of Speed in Firefighting

No matter what basic method of fire extinguishment is used, it must be used very rapidly if the fire is to be brought under control. Most fires start from quite small points of ignition, but they grow by leaps and bounds. If a fire is to be successfully extinguished, it must be done as rapidly as possible. Even a slight delay may cause the fire to grow beyond control of the available equipment.

## EFFECTS OF FIRE

When a substance burns, a number of chemical reactions occur. These reactions result in the formation of flame, heat, and smoke. They also result in the production of a number of gases and other combustion products, and frequently they cause a reduction in the amount of oxygen available for breathing. All of these effects of fire are vitally important to the firefighter, who must be prepared to protect himself against them.

### Flame, Heat, and Smoke

In order to avoid injury or loss of life, it is necessary to protect against flame, heat, and smoke. Before entering a compartment or area where a fire exists, the firefighter should be in proper dress. Pant legs should be tucked into socks. The collar should be buttoned. The firefighter should wear asbestos gloves, a helmet, a head lamp, and an oxygen breathing apparatus (OBA). The flame and the heat from a fire are intense, but proper dress will help to prevent burns. The smoke will make it hard to see and hard to breathe, but the OBA and the head lamp will help the firefighter to cope with these problems.

### Combustion Gases

Some of the gases produced by a fire are toxic (poisonous) and others are dangerous in other ways, even though they are not toxic. Some of the gases commonly produced by a fire are discussed briefly in the following paragraphs.

CARBON MONOXIDE is produced when fire occurs in a closed compartment or under other conditions where there is not enough oxygen for the complete combustion of all the carbon in the burning material. Carbon monoxide, which has the chemical formula CO, is a colorless, odorless, tasteless, and nonirritating gas. It is DEADLY even in small concentrations. A person who is exposed to a concentration of 1.28 percent CO in air will become unconscious after two or three breaths and will probably die in 1 to 3 minutes. Carbon monoxide is also very dangerous because of its very wide explosive range. If carbon monoxide is mixed with air in the amount of 12.5 to 74 percent by volume, an open flame or even a spark will set off a violent explosion.

CARBON DIOXIDE ($CO_2$) is a colorless, odorless gas that is formed by the complete combustion of the carbon in burning materials. $CO_2$ is not poisonous; its main danger to the firefighter is that an atmosphere of carbon

dioxide does not provide oxygen to breathe, and asphyxiation may result. The danger of asphyxiation is particularly great because carbon dioxide, being colorless and odorless, does not give any warning of its presence even when it is present in dangerous amounts. Carbon dioxide does not support combustion, and it does not form explosive mixtures with any substances; because of these characteristics, it is very useful as a fire extinguishing agent. It is also used for inerting fuel oil tanks, gasoline tanks, and similar spaces.

HYDROGEN SULFIDE ($H_2S$) is a colorless gas. In low concentrations, hydrogen sulfide smells like rotten eggs. Hydrogen sulfide is generated in some fires; it also occurs as the result of the rotting of foods, cloth, leather, and other organic materials. Air that contains 4.3 to 46 percent hydrogen sulfide is violently explosive in the presence of flame. Hydrogen sulfide is extremely poisonous if breathed, even in concentrations as low as 0.01 percent. Acute poisoning results from breathing hydrogen sulfide in larger concentrations; rapid unconsciousness, cessation of breathing, and death can occur in a very few minutes from breathing an atmosphere that contains from 0.07 to 0.10 percent hydrogen sulfide.

### Insufficient Oxygen

When a fire occurs in a closed compartment or similar space, an inadequate supply of oxygen for breathing may result. An enormous amount of oxygen is used by the fire itself, leaving relatively little oxygen for men to breathe. The amount of oxygen normally present in the air is 21 percent, and human beings breathe and work best with this amount of oxygen. When there is only 17 percent oxygen in the atmosphere, people breathe a little faster and deeper. When there is only 15 percent oxygen, a person is likely to become dizzy, having a buzzing in his ears, a rapid heartbeat, and a headache. When the oxygen content falls to 9 percent, unconsciousness may occur. Death is likely to result when the oxygen content of the atmosphere is 7 percent or less.

## EXTINGUISHING AGENTS

The agents commonly used by Navy firefighters include water, foam, dry chemicals, and carbon dioxide ($CO_2$). The agent or agents used in any particular case depend upon the classification of the fire and the general circumstances.

### Water

Cooling is the most common method of fire extinguishment, and water is the most effective cooling agent. Fortunately, water is usually available in large quantities. Of all the extinguishing agents now used by the Navy, water has the greatest capacity for heat absorption. Therefore, most burning substances can be cooled below their ignition points by the application of water.

Aboard ship, water is usually applied by means of the all-purpose nozzle. With the all-purpose nozzle, water may be applied as a solid stream, in the form of a high velocity water fog, or in the form of a low velocity water fog. In general, fog is preferred to the solid stream except when it is necessary to reach a fire that is some distance away or when the penetrating power of the solid stream is required. Under other circumstances, the fog is preferable because a given amount of water can absorb more heat when it is in the form of fog than it can when it is in the form of a solid stream. An additional advantage of fog is that it reduces the total amount of water that must be pumped into the ship to fight a given fire; since all water used for firefighting must be pumped overboard or otherwise disposed of, this is a definite advantage. In addition to cooling the fire, fog tends to smother the fire by displacing oxygen.

Because of the cooling capacity of the finely divided water particles, fog can be used successfully on oil fires as well as on class A fires. If fog is used on an oil fire, it is important to remember that there is great danger of reflash until the entire surface of the oil has been cooled below the flash point.

Water is not recommended as an extinguishing agent for electrical fires except as a last resort. When water is properly broken up into a fine spray by the nozzles operating at the designed pressure, the fog does not conduct electric current. But if the firefighter should accidentally shift to a solid stream, or if he should accidentally touch the nozzle or the applicator to electrical equipment, there is great danger of electrical shock. In those rare instances where it is necessary to use water

fog to fight an electrical fire, the nozzle should not be advanced any nearer to the power source than is absolutely necessary for proper utilization of the fog pattern.

Water fog affords considerable protection to the firefighter by forming a screen of water droplets between himself and the fire. This fog screen gives protection against the intense heat of the fire and thus gives the firefighter a certain amount of maneuverability in attacking the fire. Water fog also tends to dilute or absorb various vapors and to wash fumes and smoke from the atmosphere. The firefighter can help to clear smoke from the area by occasionally directing the fog pattern upward for a few seconds.

Before the firefighter enters a burning compartment, he should reduce the heat and flame by liberal application of water fog. The fog should be put into the compartment through doors and other accesses. In the early stages of a large fire, a good deal of the fog thus admitted will turn into steam. The steam will help to smother the fire. The firefighter must remember to stand clear of openings, since there is likely to be a violent outward rush of hot gases that are displaced by the steam.

Foam

Foam is a highly effective extinguishing agent for smothering large fires, particularly those in oil, gasoline, and jet fuels.

AIR FOAM or MECHANICAL FOAM is a thick, viscous, light, and stable material that floats on almost any liquid, including water. It is nontoxic, and it does not damage surfaces such as painted bulkheads. The air foam or mechanical foam consists of very small bubbles of air mixed into water which has had a small amount of foam-forming liquid added to it. Mechanical foam is capable of resisting attack by flame or heat. After the fire has been extinguished, the foam continues to seal off vapor from the surface. Foam blankets of 6 to 8 inches will last 6 to 8 hours, settling at the rate of 1 inch per hour. Some sweeping action or other mechanical process may be necessary to remove the foam.

The generation and production of mechanical foam aboard ship is accomplished by supplying a mixture of foam-forming concentrate in water under pressure to the mixing area of a nozzle, where air is drawn into the nozzle.

There are two types of mechanical foam: protein foam and nonprotein foam. The protein foam, also called low-expansion foam, in a 6-percent solution in water produces a closely knit bubble structure having an expansion ratio of eight volumes of foam per volume of foam solution. This foam has a relatively rigid structure with high heat resistance.

Nonprotein foam, also called high-expansion foam, utilizes a total flooding concept to completely fill enclosed spaces within a matter of minutes. A 2-percent to 6-percent solution in water produces foam at ratios of 100 to 1,000 volumes of foam per volume of foam solution. This is approximately 12.5 to 125 times as much foam as that produced by the protein type of foam solution. The nonprotein or high-expansion type of foam does not provide as dense a blanket as protein foam, and it is not quite as heat resistant. However, the nonprotein foam produces a much larger quantity of foam and the foam is sufficiently fluid to flow over, around, and under obstructions to enter otherwise inaccessible spaces; thus it can be used to extinguish fires anywhere in a compartment. At the present time, the nonprotein or high-expansion foam is still under test and development; it is not currently approved for shipboard use except on an experimental basis.

LIGHT WATER or Aqueous Film Forming Foam (AFFF) is a new synthetic, film-forming foam liquid designed for use in shipboard fire-fighting systems. This new agent is replacing protein foam on most naval ships. Used in foam proportioning equipment described above for protein foam, it generates a white vapor blanketing foam lighter than protein foam. In addition, it is equivalent to seawater as a fire fighting agent on class A fires.

The unique action of LIGHT WATER stems from its ability to make a light-water film float on flammable fuels. As foam is applied over the flammable liquid surface, an aqueous solution drains from the foam bubbles and floats out over the surface to provide a vapor seal. This aqueous film forming action enhances extinguishment and prevents reflash, even when the foam blanket is ruptured. Fuels which have not been ignited may also be secured for a short period of time with this same action.

LIGHT WATER can be used alone or in combination with Purple-K-Powder (PKP). Mixing of LIGHT WATER and protein concentrate is not recommended, but both agents may be

used simultaneously on the same fire after they have been discharged from their respective foam generating system.

### Dry Chemicals

Dry chemical powders extinguish a fire by a rather complicated chemical mechanism. They do not smother the fire, and they do not cool it. Instead, they interrupt the chemical reaction that is fire by suspending fine particles in the fire. In effect, the dry chemicals put a temporary screen between the heat, oxygen, and fuel and maintain this screen just long enough for the fire to be extinguished.

Several types of dry chemicals have been used as fire extinguishing agents. For Navy use, the most important agent of this kind at present is potassium bicarbonate, also known as Purple-K-Powder or PKP. PKP is used for extinguishing class B and class C fires. It is very effective against these fires. However, it is both corrosive and abrasive and should be used on class C fires only in emergencies. PKP is primarily used in portable 20-pound extinguishers. It can also be used in conjunction with light water.

### Carbon Dioxide

Carbon dioxide is a very effective agent for extinguishing fires by smothering them—that is, by reducing the amount of oxygen available for combustion. This smothering action of carbon dioxide is temporary. The firefighter must remember that the fire can quickly rekindle if oxygen is again admitted to hot embers.

Carbon dioxide is a dry, noncorrosive gas that is inert when in contact with most substances. Carbon dioxide does not damage machinery or other equipment. Since it is a nonconductor of electricity, carbon dioxide can safely be used in fighting fires that might present electric shock hazards. However, the frost that collects on the horn of the carbon dioxide cylinder IS a conductor of electricity. Therefore, rubber gloves should be worn by personnel using $CO_2$ to extinguish electrical fires.

Aboard ship, carbon dioxide fire extinguishing equipment includes 15-pound $CO_2$ extinguishers, 50-pound $CO_2$ hose and reel installations, and 50-pound $CO_2$ installed flooding systems.

Although carbon dioxide is nonpoisonous, it is dangerous to the firefighter because it does not provide a suitable atmosphere for breathing. Asphyxiation can result from breathing carbon dioxide. OBAs must be worn when $CO_2$ is used below decks or in confined spaces.

## PROTECTIVE EQUIPMENT

Special protective equipment used by Navy firefighters includes oxygen breathing apparatus (OBA), protective masks, proximity suits, asbestos suits, lifelines, and various compartment testing devices. It is essential that all Navy firefighters know what equipment is available, how to use it, and how to maintain it.

### Oxygen Breathing Apparatus

The Type A-3 oxygen breathing apparatus (OBA) is currently used by the Navy. This unit is entirely self-contained. It is designed to protect the wearer in an atmosphere that is deficient in oxygen or that contains harmful gases, vapors, smokes, or dusts. The OBA is entirely independent of any outside air. The wearer breathes in a closed system in which oxygen is supplied by chemicals in a canister which also purifies exhaled air. The OBA includes bags which store a ready supply of oxygen. A Type A-3 OBA is shown in figure 6-1.

Before donning a Type A-3 oxygen breathing apparatus, straighten all harness straps. Make a preliminary adjustment of the harness straps so the metal slides are about 3 inches from the end. One shoulder strap should be fastened to the D-ring on the breastplate. With one hand, grasp the apparatus by the central casting, dropping the facepiece over the hand holding the apparatus. Slide the other arm through the loop made by the prefastened strap and the head through the V-shaped opening formed by the crossing of the two straps attached to the breastplate. Continue to hold the apparatus on the chest with one hand, and with the other reach around to the rear at one side and grasp the free end of the harness strap. Bring the end of the strap beneath the armpit and snap it into the metal D-ring located on the top side of the breastplate. Make any final adjustment in the position of the apparatus on the body by means of the metal slides on the harness straps. The position of the apparatus should

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Figure 6-1. — Type A-3 oxygen breathing apparatus.

be such that the wearer can look up or down without having the facepiece shift or catch on the timer or main valve housing. Snap the waist strap to the small D-ring or waist strap eye bracket on the lower side corner of the breastplate, and adjust to hold the apparatus snugly to the body.

Next comes the canister. The quick-starting canister with one candle (fig. 6-2) has replaced the quick-starting canister with two candles. To place the canister in the apparatus, first remove the tear-off cap (fig. 6-3) by pulling the tab backward and downward. Then, remove the metal disc, exposing the copper foil seal. The candle cover is then removed by pulling down and in toward the center of the canister. The cover is left to hang free by the short (2") lanyard. If a swivel plate is provided, rotate the swivel plate 180 degrees, then push the plate down to remove the cover. WARNING: Do not pull the lanyard until the canister is in the apparatus and ready for actual use. To insert the canister in the apparatus, turn the handwheel to the extreme down position, and swing the bail assembly outward far enough to permit the canister to enter the canister guard. Insert the canister in the apparatus with the neck up and the concave side toward the body. (See fig. 6-3.) After the canister hits the canister stop, swing the bail back in place under the canister and turn the handwheel clockwise until the canister is locked firmly (but not too tightly) in place. The apparatus is now ready for standby service.

With the apparatus properly and comfortably positioned, and with the head harness straps properly in place through the buckles of the facepiece, fold head straps in front of facepiece, place chin in facepiece and pull straps back over the head adjusting head straps to fit the face.

Test for tightness of the facepiece by squeezing both breathing tubes and inhaling gently. The facepiece must collapse against the face or be readjusted until it does.

To put the apparatus in the active service condition: Depress the stop lever and tighten the handwheel until the canister gasket is snug against the plunger casting. Pull the lanyard straight out from the body. This removes the cotter pin, fires the candle, and inflates the breathing bags with oxygen. NOTE: The starting of the candle may be accompanied by a slight amount of harmless smoke. If venting is necessary to prevent overinflating of the breathing bags during the time (1 to 4 minutes) the chlorate candle is burning, depress the vent valve until breathing is comfortable. DO NOT touch the canister with the bare hands. The bottom of the canister will be hot.

Immediately upon inflation of the breathing bags, rotate the pointer on the timer dial clockwise to 60; then, counterclockwise to 45. This will ensure sufficient spring tension to ring the timer bell for 8 seconds.

Before entering a toxic atmosphere, always check the apparatus for tightness by squeezing both breathing tubes tightly and pulling the elbows inward against the breathing bag on each side. If the breathing bag deflates, the apparatus is not tight and must be made tight before entering a toxic atmosphere.

5.96.2

**Figure 6-2.—Front view of quick starting canister for use with type A-3 oxygen breathing apparatus.**

The chemical reaction of the single candle quick-starting canister can also be accomplished by the manual method, although it is not a recommended procedure. It is presented here for use when starting obsolete canisters or quick-starting canisters on which the chlorate candles have misfired. (This is not a common occurrence.) These canisters should only be used when there is sufficient time for the manual start or when there is a shortage of canisters. CAUTION: Under no circumstances should the oxygen producing candle be "saved" for emergency exits. Such practice is dangerous since candles have been known to misfire on occasions.

To start a canister by the manual method, proceed as follows:

1. Grasp both breathing tubes with one hand; squeeze tightly, depress the starter valve, and

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Figure 6-3.—Rear view of quick starting canister showing concave side and pull-tab tear-off cap.

inhale deeply. Release the starter valve and tubes and then exhale into the apparatus.

2. Repeat the procedure until the breathing bags are fully inflated (usually three or four breaths).

3. Depress the starter valve and deflate the breathing bags by using the arms.

4. Repeat steps 1, 2, and 3 until the bottom of the canister feels warm. Then repeat steps 1 and 2, and proceed with the work to be done.

The starting procedures just discussed are applicable when the canisters have been stowed at a temperature of 50° F or above. Cold-starting procedures are similar, except that the steps must be repeated as often as necessary to start the reaction. Best results can be obtained during cold weather by keeping the canisters inside until needed for use.

The chemical reaction in the breathing apparatus canister is caused by the moisture

and carbon dioxide in the exhaled breath. The amount of moisture and carbon dioxide in the exhaled breath is proportional to the amount of work being done or performed within the previous few minutes. A man who has been performing some kind of work, such as walking rapidly, running, or climbing ladders, just before donning the apparatus will be able to start oxygen evolution from the chemical in a relatively short period of time. On the other hand, a man who has been sitting or standing still would require a longer period to start the chemical reaction.

The life of the canister varies according to the amount of work being done by the man wearing the apparatus. The timing device on the OBA is calibrated in minutes. As previously noted, the usual setting is 45 minutes in anticipation of heavy physical labor and patrolling or other light work.

When the timer bell sounds, or when it becomes difficult to exhale, the canister should be changed by the following procedure:

1. Return to fresh air.
2. Spread your legs apart and lean the upper part of your body slightly forward.
3. Turn the handwheel counterclockwise to the extreme DOWN position, depress the canister stop, and swing the bail outward with a quick forward motion. The canister will then drop out of the apparatus.
4. Insert a new canister and put it into service as previously described.

When changing canisters, always wear asbestos mittens, leather-palmed work gloves, or equivalent protection for your hands. A used canister is very hot.

Certain precautions must be observed in connection with the chemical in the OBA canisters. The chemical contains a large percentage of oxygen, which makes it dangerously flammable and explosive in the presence of any flammable material. It is particularly dangerous if the flammable material is moist. Oil, grease, and other liquids must NEVER be allowed to enter the opening of any canister, used or unused.

The chemical in OBA canisters is very caustic and injurious to the skin. If you should accidentally get the chemical on your skin, report the nature of the injury to the medical officer or corpsman so that petroleum derivatives will NOT be applied to the affected area. Petroleum jellies make this kind of injury very much worse.

Great care should be taken to see that the chemical from used or unused canisters does not spill on the deck. If the chemical is accidentally spilled, clean it up immediately and dump it overboard, using a metal nonflammable material for a scoop.

When removing a canister, be careful to see that it does not drop onto the deck or grating where it may be near water. For example, a canister dropped on the deck could easily bounce off a grating and go into the bilges.

Disposal of used canisters must be made in accordance with similar precautions, since even the amount of chemical contained in an expended canister can be dangerous. Disposal of expended canisters should normally be made while the ship is underway, provided that the ship is not operating in close formation with other ships and provided there is no oil slick on the water. The procedure for underway disposal of canisters is to punch three or four holes in the bottom of the canister and then to throw it over the side, well clear of the ship.

If canisters must be disposed of in port or when there is an oil slick on the water or when the ship is operating in close formation with other ships, the following disposal procedure should be used:

1. Punch three or four holes in the bottom of the canister.
2. Place the canister in a container of clean water, either fresh or salt, for 24 hours.
3. Rope off the area and post warning signs.

Wear gloves and goggles with full clothing when disposing of used canisters. Avoid breathing over a canister opening; keep your face away from the opening.

The Type A-3 oxygen breathing apparatus must be tested at regular intervals. To test an OBA, place it on the deck or a work bench, in such a position that the breathing bag can be observed. Do not let the apparatus hang

from the breathing tubes because the strain could possibly damage them. Insert a canister; a partly used one will do. Put on the facepiece. Inhale, and then exhale into the apparatus. Repeat this 15 times. Grasp both breathing tubes so that they are squeezed shut. Remove the facepiece and twist the breathing tubes several times to seal the breathing bag.

Observe the breathing bag to see whether there is any noticeable decrease in size in the next minute. A decrease in the size of the breathing bag indicates leakage. If necessary, check all connections with soap suds. If leaks are discovered, they must be corrected before the apparatus is worn again.

Test the facepiece by putting it on and grasping the breathing tubes, without opening the starter valve. Then inhale. If the facepiece collapses against your face, there is no leakage.

Air-line Masks

The air-line mask shown in figure 6-4 is part of the allowance of all ship's repair party lockers. The air-line mask MUST NOT be used for fighting fires. However, it may be used to enter smoke-filled spaces, for the rescue of personnel.

3.169(188).1

Figure 6-4.—Air-line mask.

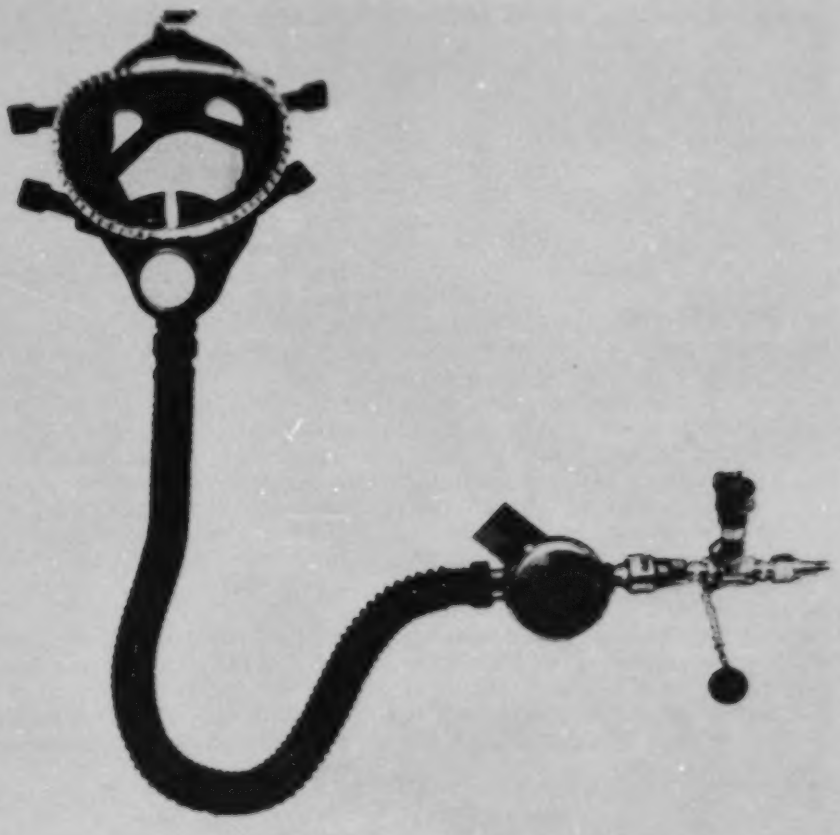
The air-line mask is a demand flow air-line respirator with a speaking diaphragm, monocular lens with adjustable head harness, breathing tube and belt-mounted demand regulator with male and female (buddy) quick-disconnect fittings. (See fig. 6-5.) A 25-foot length of hose with male and female quick-disconnect fittings is also provided for connections between the demand regulator fitting and a low-pressure air supply, or a compressed air cylinder with an intervening air regulator and air filter. The air filter consists of a particulate element and a refillable charcoal cartridge.

Information pertaining to the use, precautions, inspection, and servicing of the air-line mask is available in NAVSHIPS Technical Manual, chapter 9880, section 2, items 9800-1035 through 9880-1041.

Tending Lines

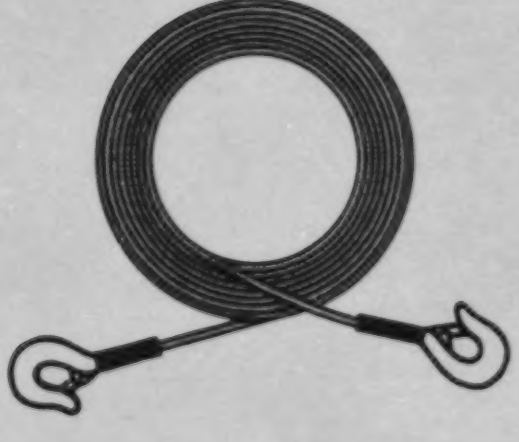
The fifty-foot nylon-covered, steel wire tending line shown in figure 6-6, is available for use aboard ship for use with the oxygen breathing apparatus or the air-line mask. The tending line is equipped at each end with a stout hook that is closed with a snap catch. The line has a maximum of pliability and slides freely around obstructions.

Tending lines are used as a precautionary measure to facilitate the rescue of an overcome investigator or firefighter who is wearing an oxygen breathing apparatus, air-line mask, or similar equipment. Rescue, if necessary, should be accomplished by having another man, or men equipped with breathing apparatus, follow the tending line to the person to be rescued, rather than by attempting to drag the person out by the tending line. Attempts to drag a person out of a compartment by the tending line may very well result in the line becoming fouled on some obstruction or in parting the wearer's harness with a resultant loss of time, so that it will still be necessary to send a rescue man in. If rescue is to be effected promptly, a rescue man must, of course, be equipped with a breathing apparatus ready for immediate use and must be standing by ready for immediate entry.



3.169(188).2

Figure 6-5.—Air-line mask with buddy fitting.



136.36

Figure 6-6.—Tending line.

When the oxygen breathing apparatus is used for inspecting damage or fighting fires, a team of one wearer and one man to handle the tending line should work together. If it becomes necessary for two or more oxygen breathing apparatuses to be in use in the same compartment, the tending lines are not used, and the OBA wearers should keep in constant sight or touch of one another.

A team of OBA wearers and their tenders are to use the following system of line signals.

| Code | Pull | Meaning |
|---|---|---|
| O | 1 | OK |
| A | 2 | Advance |
| T | 3 | Take up |
| H | 4 | Help |

CAUTION: A stricken person must never be hauled by a line attached to his waist. He may be dragged a short distance along the deck, but his weight must never be suspended from his waist. If the wearer lacks any sort of shoulder harness, the line must be made fast so that it passes around the arms, and meets either in front or the back. The tender should wear rubber gloves and shoes when handling steel tending lines or cables.

Proximity Fire Fighting Suit

The proximity fire fighting suit, shown in figure 6-7, provides the wearer with thermal protection while approaching and operating close to large fires. It will also allow entry into overheated or steam-filled compartments to bring fires under control, the rapid investigation after fire is under control, and the effecting of rescue of aircraft personnel when crash fires occur.

The proximity fire fighting suit consists of a one-piece coverall, gloves, a hood, and boots. The hood provides a covering over the oxygen breathing apparatus when it is worn. The material used in the coverall, gloves, and hood is asbestos cotton, aluminized on the outside for reflective purposes. The boots are rubber. The proximity suit also resists the penetration of liquids.

103.148(188)

Figure 6-7.—Proximity fire-fighting suit.

The approach concept of the proximity fire fighting suit precludes the use of the suit for fire entry purposes. This use, in coordination with firefighting protective techniques, does not contemplate the necessity for the wearer to move through flames, or through flaming and burning liquid fuels.

FIRE PREVENTION

Fire may start aboard ship from an enemy hit, from a cigarette or match carelessly thrown away, from the spontaneous ignition of various combustible substances, from the use of sparking tools in an atmosphere containing explosive vapors, from the improper stowage of flammable materials, from static electricity, and from many other causes.

The list of things to be checked and inspected as a means of preventing fires could be extended almost endlessly. Instead of going on with a list, however, it may be more useful at this point to stop and formulate a few general rules for fire prevention:

RULE 1: Learn to look at everything with an eye for possible fire hazards. Develop a special kind of alertness for situations or actions that could conceivably lead to fire.

RULE 2: Insist on proper stowage and good housekeeping procedures. Report violations to the proper authority.

RULE 3: Maintain all firefighting equipment in a state of maximum readiness. While this won't prevent a fire from starting, it is the best possible means of preventing the spread of fire.

RULE 4: Make sure that all firefighting personnel are trained to be alert to fire hazards, as well as being trained in firefighting operations.

RULE 5: Keep up with new firefighting equipment and new firefighting techniques. The Navy is constantly working to provide improved firefighting equipment and improved fire-fighting techniques. It's up to you to keep abreast of new developments in firefighting and fire prevention.

## CREWS

### HANGAR DECK CREW

The Hangar Deck Officer (V-3 Division Officer) is normally responsible for the 1-H repair stations. In addition to the ABH, men from the MM, HT, HM, and EM or IC ratings are normally assigned to these repair stations. The Hangar Deck Chief is second in charge of the party. The hangar deck crew is responsible for the operation of assigned firefighting equipment such as the hangar sprinkler systems, water curtains, high capacity fog foam (HCFF) monitors, handlines, aqueous film-forming foam (AFFF) handlines, aircraft elevators, conflagration stations in hangar bays 1 and 2, and the hangar separation ballistic doors. If the hangar deck is involved in a fire, the Hangar Deck Officer is charged with the safety of personnel and equipment and the activation of the appropriate firefighting equipment.

#### Flight Quarters

Repair 1-H will not be fully manned during flight quarters unless specifically ordered by the air officer. The partial manning of this repair party during flight quarters normally consists of manning the conflagration station in each hangar bay area assigned to the repair party. Two men are normally utilized in manning each station. One man serves as talker and controls operator. The other man assigned serves as a roving patrol for the hangar bay area served by his assigned station.

#### General Quarters

During general quarters, Repair 1-H is responsible for the material condition of the hangar deck structures and the hangar deck machinery and firefighting equipment forward of and including the after hangar bay doors (division doors). This includes the aircraft elevator machinery, platforms, roller curtains, elevator doors, hangar bay doors, and such firefighting equipment as $CO_2$ extinguishers, foam monitors, hangar deck sprinklers, aqueous film-forming foam handlines, and other sea water outlets.

This machinery and the equipment, other than the aircraft elevators, are normally operated by members of these repair parties during general quarters. The elevator safetymen and the men manning the elevator machinery spaces are usually members of these repair parties. The material condition and the operation of the hangar deck lighting system are also a responsibility of Repair 1-H.

#### Firefighting Equipment

The hangar deck of an aircraft carrier is one of the most dangerous fire areas on the ship. There is always a large quantity of fuel in the aircraft spotted there with the ever-present danger of leakage. Aircraft must be spotted very close together, which can present a problem in getting to the source of a fire. Due to the ever-present danger of fire and the difficulty of reaching it, most of the firefighting equipment on the hangar deck can be operated by remote control. These remote controls are located in the conflagration stations.

CONFLAGRATION STATIONS.—A conflag station is provided in each hangar bay. This station must be manned at all times by fully qualified personnel. These men are responsible for the proper and timely use of firefighting equipment on the hangar deck that can be operated by remote controls installed in their stations.

Each hangar foam monitor control is duplicated in the conflag station. An open-close pushbutton is located in the conflag for each monitor in the same bay with the conflag station. On ships which have hangar division doors, a master switch and remote indicating lights are provided for starting all monitors in the adjoining hangar bay(s). No close position is provided with the master switch(es). In instances when it is necessary to resort to the use of the master switch, starting of the remote foam system will energize the indicator lights associated with the master switch.

There are also controls in the conflag station for operating the hangar division (fire) doors, elevator doors, and lighting system associated with the hangar bay in which it is located.

BALLISTIC DOORS (FIRE DOORS).—Fire or division doors are large metal doors athwartship that are used to divide the hangar

deck into sections (bays). This compartmentalizing of the hangar deck facilitates the isolation of hangar deck fires and/or NBC contamination. Also, as their name implies, they limit the ballistic damage on the hangar deck due to explosions. Hangar deck personnel must ensure that no aircraft or equipment is spotted in such a manner that blocks the operation of these doors.

HIGH-CAPACITY FOG FOAM MONITORS AND HANDLINES.—The hangar deck foam hose stations are located alternately port and starboard in the general vicinity of the injection stations from which they are supplied. Equipment at each of these stations consists of one 3 1/2-inch and one 2 1/2-inch foam nozzle with quick-acting shutoff valve, stream shaper for each nozzle, 150 feet of 3 1/2-inch and 100 feet of 2 1/2-inch cotton rubber-lined hose; 100 feet of each size hose should be connected to the foam service outlet valves ready for use. The monitor stations are fitted with a 3 1/2-inch outlet and a 2 1/2-inch hose valve. A swivel-type monitor is connected to the 3 1/2-inch outlet. Monitors are fitted with 3 1/2-inch fog-foam nozzles and stream shapers. These nozzles do not contain quick-acting shutoff valves. A 2 1/2-inch foam nozzle and stream shaper are also provided at each monitor station. The 2 1/2-inch firehose for these stations is obtained, as required, from adjacent fireplugs.

A pushbutton is provided adjacent to the monitors for operating the station. In order to prevent inadvertent operation of the station, the pushbutton is fitted with a sheet-metal enclosure.

Each hose or monitor station is connected to the injection station by the X50J sound-powered telephone circuit.

A buzzer is provided at each outlet for calling the injection station. The conflagration control station can call each injection station supplying outlets in the same or adjacent hangar bays by means of a selector switch.

Generally, where the fire is over 40 or 50 feet from the monitor, the stream shaper should be put on the nozzle to ensure that the foam will reach the fire. The stream shaper cannot be placed on the nozzle while it is in operation. Operating the pushbutton controlling the valve in the monitor supply branch is the only action required to put the monitor in operation.

The monitors may also be put into operation from the second deck by means of the manual control in the solenoid which operates the 4-inch valve. This means of operation should be reserved for large fires which make local control of the monitor remote control from the conflagration station impossible or where electrical control fails. Since hangar conflagrations are always a possibility whenever fueled aircraft are present in a hangar, the monitor should always be trained athwartship at the angle of elevation (or depression) calculated to give the greatest coverage without undue impingement on the overhead or parked aircraft.

The monitors can be operated with little or no decrease in efficiency, with the barrel removed from the yoke. Removal of the barrel will decrease the length about 15 inches and will permit the monitor to be trained athwartship with practically no interference to planes parked nearby. The threads on the monitor yoke are the same as those on the barrel so the change can be made without any alterations. There are a few monitor stations which are recessed alongside of bulkheads. Retention of barrels on these monitors will be necessary in order to avoid blanking off portions of the area protected.

FIREFIGHTING.—NOTE: In the event of a fire on the hangar deck, the FIRST and IMMEDIATE response will be made by the Shipboard Twinned Agent Unit (SBTAU).

As has been previously stated, foam service outlets are installed fore and aft of the hangar deck, port and starboard. The 3 1/2-inch foam service outlets at these stations are not fitted with monitors. A study of fires which have occurred on aircraft carriers reveals that the majority of fires take place at or near the midship section, leaving the fore and aft ends of the deck relatively safe for the launching of firefighting operations after any initial blasts have subsided. It is intended that spare firehoses and nozzles be stowed behind bulkheads in sheltered spaces close to these fore and aft foam service outlets. It has also been determined that satisfactory progress can be made in hangar deck firefighting where fire parties advance from the fore and aft ends,

simultaneously converging on the fire with high-capacity foam gear. As progress is made toward the fire, supplementary foam lines can be operated from other foam service outlets made accessible in the course of the advance. Operations of the monitor nozzle foam streams and lines out of range as a result of the advance should be secured by the fire parties as soon as possible to prevent too great a drain on the system.

It is not recommended that the hangar deck sprinkling system be operated while using the foam system. The sprinkling system can be used effectively to control the intensity of a hangar deck conflagration should events prevent immediate application of fog foam. It should be secured immediately when the fog-foam system is started. The capacity of the ship's pumps is not sufficient to supply both the hangar deck sprinkling system and the fog-foam system simultaneously with pressures required for efficient operation. Judicious use can be made of the hangar deck sprinkling system for cooling down the structure after the fire has been extinguished. Extreme care must be exercised while doing this to prevent the foam blanket from being broken up to the extent that reflashes may occur.

When general, fire, or flight quarters are sounded, all foam injection stations should be manned and foam proportioner pumps primed and placed in operating condition. If fire develops on the hangar deck, water curtains at both extremities of the area involved should be placed in operation; and hangar doors should be closed to form a boundary for the fire. Foam monitor nozzles covering the involved area should be turned on, thereby reducing the temperatures within the area and furnishing a foam blanket. If fire or other damage makes foam monitor nozzles within the involved area inoperative, the 2 1/2- and 3 1/2-inch foam lines located forward and aft should be advanced into the involved area to extinguish the fires. When the fire is beyond the reach of the 3 1/2-inch hose lines at the fore and aft ends of the hangar deck, the hoses should be brought up and connected to the nearest operable monitor outside the involved area. The use of the stream shapers on the portable lines will be dependent upon the severity and extent of the heat wave created by the fire. They should not be used at close range since the foam is delivered with such force to a localized area that it tends to break up the foam blanket. Monitor nozzles should be shut down when mopping up (with the 2 1/2-inch lines) has been started; and the water curtains should be cut off as soon as all fire has been extinguished and the involved area sufficiently cooled to be certain that no flashback will occur.

The reflash watch should then be set with as much equipment as was used at the end of the fire. New crews should be assigned with leaders who were on the original fire party (when possible). A maximum effort should be then made to reservice the foam injector stations. Some sort of effective security from the crowd which collects should be established. The foam blanket should be kept intact as long as necessary to ensure that the heat retained in the metal decks, etc., does not cause reignition. Remember, foam also insulates and prevents rapid dissipation of the heat. One method of determining the heat retention of decks, etc., is to check the metal temperatures on the backside of the metal plates that were involved in the fire area.

### Aqueous Film-Forming Foam (AFFF)

In the mid-1960s the Navy developed a new fuel vapor sealing agent, again a mechanical foam when mixed with water and air, but three to four times as effective as protein foam in fighting flammable liquid fires. This new agent is called aqueous film-forming foam (AFFF). AFFF has been used in shore-based firefighting equipment since 1967, and it became the formally established fire-protection agent ashore in March 1970.

AFFF is now considered to be a suitable firefighting agent for use throughout the ship in all foam-generating systems, replacing all protein foam. The present AFFF concentrate is a low viscosity, water-soluble, perfluorocarbon surfactant that is light amber colored. Unlike protein foam, AFFF can be sprayed vigorously over the surface of the fire; the AFFF foam-vapor seal remains intact in foot traffic and is not as fragile as protein foam.

This easier application and the reduced reflash hazard contribute to the effectiveness of AFFF. Numerous tests and demonstrations have clearly proven the superiority of AFFF relative to protein foam in combating large-scale liquid surface pool or spill fires. This

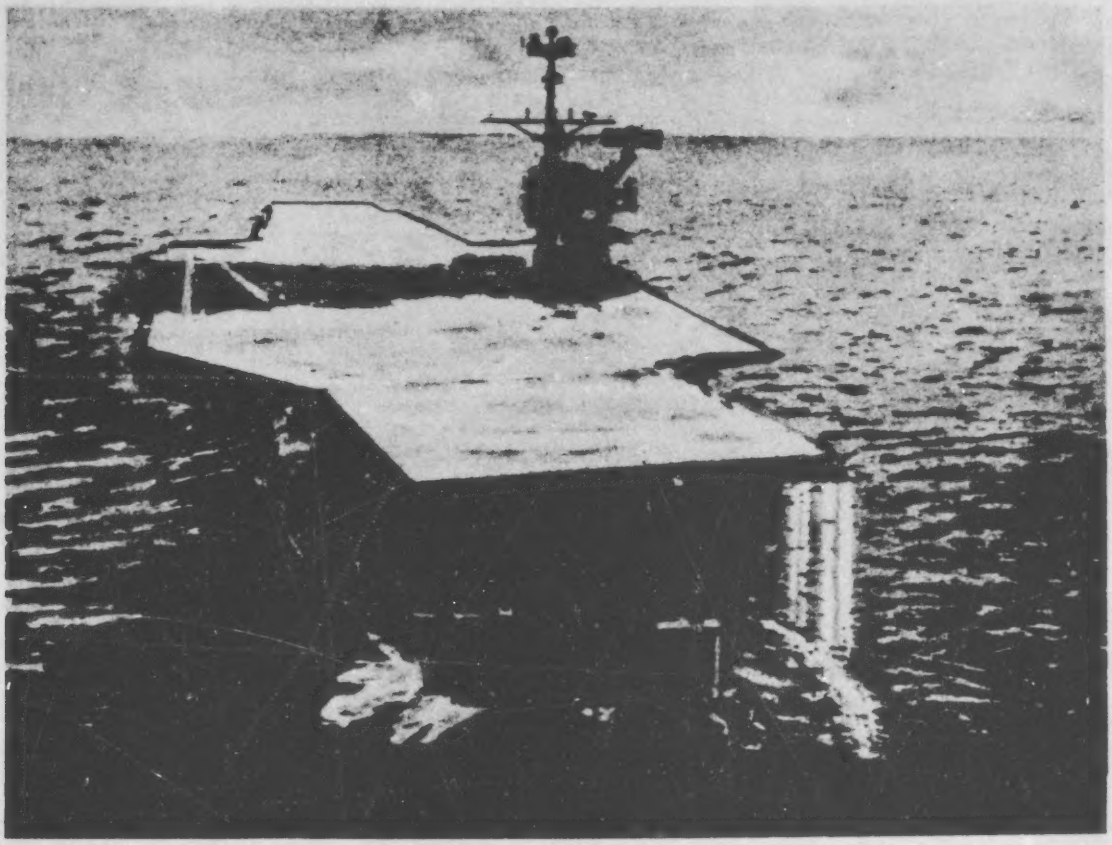
superiority has been substantiated by reports of actual shipboard fire extinguishment. The modern sailor now has a firefighting agent that is effective and rugged for fighting his oil-spill fires.

To improve shipboard protection with this new firefighting agent, the Navy has a program to convert all protein-foam-generating firefighting equipment aboard surface ships to AFFF.

The first shipboard systems converted to AFFF were aircraft-carrier hangar and flight-deck equipment providing for rapid implementation of the agent in these high fire hazard areas in which highly combustible aviation fuel spills and accidents were frequent. SHIPALTs have been issued to convert aircraft carrier protein foam equipment to AFFF in the high capacity fog foam (HCFF) stations, hangar sprinkling and machinery spaces. SHIPALTs have also been issued to provide AFFF to fixed flight-deck firefighting, washdown systems. Figure 6-8 shows a flight deck being covered by the fixed washdown system using AFFF.

The hangar deck is also equipped with hard rubber hoses to dispense the AFFF solution.

In most cases the protein foam equipment can be converted to AFFF operation by cleaning



200.45

Figure 6-8.—Water washdown system dispensing AFFF.

(flushing) the equipment and substituting AFFF. The chief exceptions to this are FP-180 and FP-1000 foam proportioners and the firefighting systems that contain these proportioners. Proper operation of the protein foam system is determined by the color-comparison method or refractometer analysis of the protein agent salt-water mixture to assure proper proportioning. Four percent protein foam concentrate in the mechanical foam mixture is the minimum allowed and indicates proper equipment operation.

The minimum percentage of AFFF concentrate allowable in the foam mixture is 3.5 percent.

The refractometer is the instrument used to analyze the AFFF-salt water mixture. The approved refractometer is American Optical Instrument Company catalog number 10430 or equivalent, NSN 1H 6650-00-107-8509. For operation of the refractometer see Maintenance Requirement Card (MRC) 92 B88V Q for the procedure for AFFF systems in machinery spaces or MRC 13 C33R A for AFFF-HCFF stations. Both are indicated on Maintenance Index Page (MIP) A-639.

The can opener fill-type opening on top of the tank should be a gasketed, air-tight screw plug. Pouring from the new AFFF containers into the tank may be difficult. The screw cap should be the fill connection type, or a filling funnel should be available at the tank.

A pressure/vacuum relief vent should be installed in the top of the tank which will permit air flow in either direction. A thin sheet of neoprene, sufficiently contained and protected, with a slit is acceptable. The vent should be installed so that it does not permit entrance of dirt particles into the tank.

The tank should be filled with AFFF Formula FC200 concentrate. To minimize possible corrosive action, tanks should be maintained totally filled and free of salt-water contamination. (Accelerated tank corrosion can be expected if contaminated with salt water.)

Firefighting instructions are given in great detail in NAVSHIPS Technical Manual, Chapter 9930.

MOVEMENT OF AIRCRAFT FROM FIRE ARRAS.—Movement of aircraft from or on the hangar deck during a hangar deck fire is severely restricted. Once a fire starts, the division doors must be closed and no aircraft can be moved. Aircraft may have to moved on the hangar deck to provide access to a fire in a compartment whose entrance is from the hangar deck. At times it may also be necessary to move aircraft away from a potentially hazardous area such as a large fuel spill.

At times when jet-engined aircraft are taxied directly onto an elevator and lowered to the hangar deck, a fire may occur in the engine or engine bay from excess fuel when the engine is shut down. When the fire is in the engine tailpipe, the fire normally can be extinguished by dry running the engine, using a starter unit. When the aircraft is on a center-of-the-deck elevator, the elevator must be raised to the flight deck level to perform this operation. On a deck edge elevator it may be performed on the hangar deck level. When the fire is not in the engine but in the engine bay or fuselage, $CO_2$ must be introduced through one of the fire doors to extinguish it. Some carriers may require that an aircraft fire of any nature upon engine shutdown on the hangar deck be sent to the flight deck level.

The ship's instructions should cover the procedures to be taken in regard to hangar deck fires. The hangar deck chief and leading PO should be familiar with these instructions and the procedures for extinguishment of fire in all types of aircraft that may be assigned to the ship.

## FLIGHT DECK CREWS

In a fire or other emergency situation, the flight deck crews will keep in mind their primary function as aircraft handlers, moving aircraft that hinder firefighters from controlling conflagrations or aircraft that would otherwise be damaged by fire; however, they must be ready for immediate response to fire and/or an emergency situation either by taking the proper action personally or in direct support of the Crash Salvage Team.

NOTE: The primary duties and responsibilities of the Aircraft Crash Salvage Team are discussed in chapter 4 of this Rate Training Manual.

### Flight Quarters

During flight quarters, the major concerns of the Crash Salvage Team are the handling

of crashed aircraft and the manning of key firefighting equipment and/or apparatus, while two men dressed in aluminized fire-protective suits stand by in the fly two area or as directed by the Crash Salvage Officer.

The Air Officer is charged with the general direction in the handling of all crashes which occur; the Flight Deck Officer is charged with the general supervision of the flight deck in the vicinity of the crash or emergency area.

A medical officer (flight surgeon) and one or two HMs are on duty on the flight deck during flight quarters in order to render first aid to personnel involved in mishaps related to flight operations.

General Quarters

During general quarters, the Crash Salvage Team becomes part of the damage control organization. The damage control organization is discussed in detail in chapter 7 of this manual.

Equipment

Some of the equipment and firefighting apparatus related to flight operations on the flight deck is similar to the equipment previously described for the hangar deck crews. The high capacity foog foam (HCFF) stations on the flight deck correspond to those on the hangar deck and are supplied with foam/sea water solution from the injector station below decks. The fireplug locations are placed so that the best deck coverage is available. Other equipment includes the SBTAU (Shipboard Twinned Agent Unit), portable $CO_2$ and P-K-P (dry chemical) extinguishers, and MB-5 crash rescue trucks. As on the hangar deck, in the event of fire on the flight deck, the FIRST and IMMEDIATE response will be made by the MB-5, until the third generation TAU is available throughout the fleet.

Water Washdown Systems

Due to the exposed nature of the flight deck, over which the Crash Salvage Team has responsibility during general quarters for damage control purposes, personnel assigned to this team must have a thorough knowledge of nuclear, biological, and chemical warfare. Drills conducted by the Crash Salvage Officer should emphasize training in these matters as well as standard damage control procedures.

The purpose of the washdown system is to help minimize the effects of the radiation hazards of radioactive fallout by creating a spray of water over the entire flight deck and flight deck area. The two types of systems being utilized are as follows:

1. The permanent system. This system consists of an arrangement covering the entire flight deck and consists of flush deck type nozzles which are fed by piping installed under the flight deck. During an actuality, word will be passed from the carrier's DCC (Damage Control Central), "Commence water washdown." Supply valves feeding the system are then turned on, putting it into operation.

SHIPALT 3410 provides for a light water capability for the water washdown system as a firefighting option of the permanent systems only. Briefly, this water washdown/light water firefighting system is as follows:

a. The flight deck portion of the washdown countermeasures system, depending on each particular flight deck, is rearranged into 12 to 20 zones. Each zone is 125 feet long and covers approximately half the width of the flight deck. Additional sprinklers are provided to cover the after end of the flight deck, and any other flight deck area which would not be covered during a condition of zero relative wind, at the rate of 0.06 gallons per minute per square foot.

Existing plastic piping in the flight deck areas or zones must be replaced with suitable metallic piping.

b. All existing HCFF (High Capacity Fog Foam) 300-gallon protein foam concentrate tanks are replaced with 600-gallon stainless steel (CRES) tanks for the stowage of the fluorocarbon concentrate, and the original stowage racks and equipment are removed for the refill supply of protein foam concentrate. Refill of the fluorocarbon concentrate is accomplished by a 1 1/2-inch fire hose connection near the top of the tank.

c. Positive displacement pumps are installed on a one tank-one pump-one zone basis to inject the fluorocarbon concentrate at the rate of 6 percent, plus or minus 1 percent, into the salt water supply lines to the washdown system. An exception is the fantail sprinkling/aftermost zone of the flight deck,

which may be served on a one tank-one pump-TWO zone basis.

d. Duplicate control panels are installed in both Primary Fly Control and the ship's pilot house. These panels are laid out as flight deck diagrams, with the controls for each zone in the corresponding zones of the panels.

Pushbutton controls are provided for operating any zone as a water sprinkling system (washdown), or as a Light Water firefighting system (i.e., separate buttons for sprinkling group control and for injector pump control).

Indicator lights for each zone are also provided to show SALT WATER ON, INJECTOR ON, and INJECTION OFF. INJECTION OFF must be wired to function only when SALT WATER ON is lighted. A lockable, two-position master switch, as part of, or adjacent to each panel, must be installed. This switch must have sections wired in series with the SALT WATER ON buttons of the local panel. This switch is also wired to sound an alarm in the ship's Damage Control Central.

The fantail sprinkling system is controlled by independent controls installed in the jet engine test stand control cubicle on the fantail.

The HCFF (High Capacity Fog Foam) generators operate independently of the water washdown/light water firefighting system; however, they deliver proportioned salt water and fluorocarbon mixture for firefighting operations.

2. The interim system. This system is installed on the older type carriers or carriers that do not have the permanent provision. The interim system is portable since flight deck operations cannot take place with the system installed. This system consists of quick connecting, lightweight aluminum pipes with spaced nozzles. Each array of pipelines is laid out athwartships at about 40-foot intervals. Then each array is attached to the deck edge fireplugs by a short length of fire hose. Additionally, each array must be secured to the aircraft tiedown padeyes to prevent them from being blown about by the wind. The standard protective covers that are provided for aircraft should be installed on each aircraft on the flight deck (time permitting) to prevent salt water and/or contamination from getting into the aircraft.

Flight Deck Repairs

After any aircraft crash, the flight deck must be checked for and cleared of any loose gear and parts. Any damage to the deck that would affect the recovery of aircraft must be temporarily repaired.

Methods of effecting temporary repairs should be studied, and materials for making repairs should be assembled, prefabricated, and stowed in the most convenient locations. Drills should be conducted to familiarize the crash salvage team (flight deck crews) in the locations and methods of assembly and use of the prefabricated materials.

Due to the wide variation in the extent of damage to the flight deck, prefabricated patches of various sizes must be provided.

Many holes in flight decks may be repaired by covering them with steel plates. Plates of various sizes should be provided. Plates to be used in repairing wood decks should have 5/16-inch holes drilled along the edges. These plates may be secured to wooden decks by using 60d nails which have been cut into two parts. Only the part bearing the head is used. The cut end of this part is flattened prior to use. Plates that are to be attached to metal flight decks must be welded. The edge(s) facing approaching aircraft in the landing area must be welded in a continuous bead to prevent the possibility of engagement of an aircraft arresting gear hook. The opposite edge (forward) can be tack welded unless additional strength is required due to the nature of the damaged area. In the latter situation, continuous bead welding is necessary.

Holes that cannot be covered with a single plate may be patched with a series of plates. Additional strength members (I-beams) must be added. When flight operations have been completed, the temporary patch can become a semipermanent one by welding an I-beam to the web of the new temporary deck beams and the permanent deck beams.

Detailed instructions for making temporary and semipermanent repairs are covered in chapter 9880, Section 3, NAVSHIPS Technical Manual, Stock Number 0901-883-0002.

# CHAPTER 7

# SHIPBOARD DAMAGE CONTROL

Damage control is defined as the measures necessary to preserve or reestablish watertight integrity, stability, maneuverability, and offensive power; to control list and trim; to effect repairs of material; to limit the spread of and provide adequate protection from fire; to limit the spread of, remove the contamination by, and provide adequate protection against the effects of chemical and biological agents or noxious gases and nuclear radiation; and to provide for the care of wounded personnel.

Damage control includes the functional combination of all equipment, material, devices, and techniques designed to prevent, minimize, or remove damage which occurs in wartime or peacetime, and make emergency repairs. This includes passive defense for conventional, nuclear, biological, and chemical attack, and all active defense measures short of those designed to prevent successful delivery of an enemy attack by military means or sabotage.

The three basic objectives of shipboard damage control are to:

1. Take all practicable preliminary measures to prevent damage.
2. Minimize and localize such damage as does occur.
3. Accomplish, as quickly as possible, emergency damage repairs, restoration of equipment, and the care of injured personnel.

These objectives are attained by:

1. Preserving stability and fume and watertight integrity (buoyancy).
2. Maintaining the operational capability of vital systems.
3. Preventing, isolating, combating, extinguishing, and removing the effects of fire and explosion.
4. Detecting, confining, and removing the effects of radiological, biological, or chemical contamination.
5. Preventing personnel casualties and facilitating care of the injured.
6. Making rapid repairs to structure and equipment.

The damage control organization has the same objectives in peace and war, although the threat is accentuated in war. Upon its effectiveness will depend the ship's ability to perform its assigned mission.

## RESPONSIBILITY FOR DAMAGE CONTROL

Every member of the ship's company must realize his responsibility toward damage control and the importance of the subject. The importance of efficient damage control cannot be overemphasized, and the desired state of readiness can only be achieved by a firm program stimulated by effective and dynamic leadership and executed by enthusiastic, well trained, and determined officers and crew from all departments aboard each ship. While no area can be fully covered, the basic responsibilities of key individuals toward damage control are set forth in the succeeding paragraphs.

NWP 50 prescribes duties and functions of various ship's personnel. The responsibilities outlined herein are applicable to damage control and are not intended to supersede or cancel those responsibilities in NWP 50. The basic responsibilities of key individuals for damage control are given in this section.

### COMMANDING OFFICER

Within Chapter 7, U. S. Navy Regulations, which delineates the various broad responsibilities of the commanding officer, are the

requirements that he. . . "maintain his command in a state of maximum effectiveness for war service. . ." and that he "Immediately after a battle or action, repair damages so far as possible, (and) exert every effort to prepare his command for further service. . ."

To carry out this charge, the commanding officer must ensure that his command is adequately trained and continually exercised in all aspects of damage control. He should be fully aware of all of his ship's weaknesses in this area, including the adequacy and operability of all damage control equipment. Shortages and defects must not be tolerated; they should be immediately rectified.

## EXECUTIVE OFFICER

The executive officer keeps the command advised of the status of the ship's damage control readiness. He carries out the requirements of command regarding damage control training, and the ship's readiness to combat all casualties and damage resulting from a hostile act or other occurrence, in war or peace, which threatens the ship. The executive officer must be intimately familiar with damage control evolutions and he maintains overall supervision of all actions incident to damage control, including drills, from a prescribed and distinct vantage point.

## OFFICER OF THE DECK

The officer of the deck (OOD), as senior member of the underway watch team, is the primary assistant to the commanding officer on the bridge. To properly perform his duties, he must be intimately familiar with the ship, its material condition, and established procedures for emergencies. With respect to damage control procedures, he should know and understand the correct course of action, or options, for various situations. He should be prepared to promptly analyze a situation and take prompt, positive, and correct counteraction. It is possible that the OOD could be on the bridge in the absence of the commanding officer and find himself in the position of having to maneuver the ship during a serious fire, compounded by explosions. His ability to react properly and promptly will be directly proportional to his knowledge of the ship, damage control procedures, equipment available, and the training he has received.

## COMMAND DUTY OFFICER IN PORT

The command duty officer in port is that officer, eligible for command at sea, who has been designated for a prescribed period of time by the commanding officer as deputy to the executive officer for carrying out the routine of the ship in port, and for supervising and directing the OOD in matters concerning the safety and general duties of the ship. In the temporary absence of the executive officer, his duties will be carried out by the command duty officer in port.

The duties, responsibilities, and authority of the command duty officer in port are:

1. Advise and, if necessary, direct the OOD in matters concerning the general duties and safety of the ship.
2. Keep informed of the ship's position, mooring lines or ground tackle in use, the status of the engineering plant, and all other matters which affect the safety and security of the ship.
3. In times of danger or emergency, take action as appropriate until an officer senior to him in the succession of command relieves him.
4. Relieve the OOD when necessary for the safety of the ship, and inform the commanding officer when such action is taken.

## DEPARTMENT HEADS

Adequate damage control readiness can be achieved only by the participation of all departments aboard ship. For this reason, certain responsibilities are common to all department heads. These include:

1. Ensure optimum material conditions of readiness within the department, as prescribed by compartment checkoff lists provided by the damage control assistant (DCA).
2. Provide for continual, periodic inspections of department spaces by an officer in accordance with current Planned Maintenance System (PMS) procedures.
3. Require that damage control equipment and fittings be maintained in their proper locations and in operating order.
4. Assign specific damage control duties to individuals within the department, including the designation, and qualifications by the DCA, of

a departmental damage control chief petty officer and division damage control petty officer (DDCPO).

5. Provide personnel to damage control, repair, fire, salvage, rescue parties, etc. as required by ship's organization bills.

6. Require securing of department material and equipment against possible damage by heavy weather.

7. Require an immediate report to be made to the DCA of any deficiency in damage control markings, devices, fittings, equipment, or material, and initiate corrective action.

8. Train personnel in damage control matters, in coordination with the DCA.

9. Be prepared to strip ship or clear for action, in accordance with the ship's instructions.

ENGINEER OFFICER

The engineer officer is responsible under the commanding officer, for the operation, care, and maintenance of the main propulsion plant, auxiliary machinery, and piping systems; for the control of damage; for the operation and maintenance of electric power generators and distribution systems; for repairs to the hull; and for repairs to material and equipment of other departments which are beyond the capacity of those departments but within the capacity of the engineering department.

In amplification of the duties prescribed in U.S. Naval Regulations, the engineer officer is required to:

1. Maintain the hull, machinery, and electrical system in battle readiness.

2. Supervise firefighting. (Control of aircraft fires is the responsibility of the air officer in ships having an air department.) He is responsible for adequacy of the fire bill and for assigning and instructing personnel in accordance with provision of the bill.

3. Maintain interior communication equipment.

4. Control and restore engineering and ship control casualties.

5. Coordinate all naval shipyard work and correspondence or communications relating to alterations or repairs to the hull and installed equipment.

6. Maintain the PMS and other operating and maintenance records.

7. Act as technical assistant to the executive officer in carrying out nuclear, biological, and chemical (NBC) defense procedures.

8. Provide ship facilities, equipment, and key personnel required for repairs to the hull and machinery, and for repairs to material and equipment of other departments but within the capacity of the engineering department.

9. Organize Repair (party) 5 in accordance with the battle bill.

10. Supervise the training of Repair 5.

11. Assign appropriate engineering ratings to other repair parties in accordance with the battle bill.

DAMAGE CONTROL ASSISTANT

The damage control assistant (DCA), who is under the engineer officer, is responsible for establishing and maintaining an effective damage control organization. Specifically, the DCA is responsible for the prevention and correction of damage, the training of ship's personnel in damage control, and the operation, maintenance, and care of certain machinery, drainage, and piping systems not specifically assigned to other departments or divisions.

DDCPO

On large ships the departmental damage control chief petty officer (DDCPO) coordinates the relieving, qualifying, training, and duties of the DDCPOs as directed by the DCA and fire marshal. He performs other duties as directed by type commanders.

A qualified senior petty officer in each division is designated DDCPO. Section leaders of each section are designated as duty DDCPOs outside of normal working hours in port, and must perform the duties of the DDCPO during their tour of duty. Division officers notify the fire marshal and the DCA of the names of the DDCPO and the duty DDCPOs and keep them advised of any changes to personnel so assigned.

DDCPOs and duty DDCPOs normally serve for a period of three months and check in and out with the fire marshal and DCA upon being assigned to or released from such duties.

The DDCPO and duty DDCPOs (duty section leaders) are required to:

1. Acquaint themselves with all phases of the ship's damage control firefighting and defense procedures.

2. Assist in the instruction of division personnel in damage control, firefighting, and NBC defense procedures.

3. Ensure the preparation and maintenance of damage control checkoff lists for all spaces under their cognizance.

4. Supervise the setting of specified damage control material conditions within division spaces and make required reports.

5. Weigh portable $CO_2$ bottles, inspect and test damage control and firefighting equipment, and prepare required reports for approval of the division officer in accordance with current ship's instruction.

6. Ensure all battle lanterns, dog wrenches, and spanners and other damage control equipment are in place, and in a usable condition in all division spaces.

7. Ensure all compartments, piping, cables, and damage control and firefighting equipment are properly stenciled or identified by color codes.

8. Ensure the posting of safety precautions and operating instructions in required division spaces.

9. Assist the division officer in inspection of division spaces for cleanliness and preservation, and assist in the preparation of required reports.

10. Conduct daily inspections of division spaces for the elimination of fire hazards.

11. Perform such other duties with reference to damage control and maintenance of division spaces as may be directed by the division leading petty officer, division officer, fire marshal, and the DCA.

## DAMAGE CONTROL ORGANIZATION

The damage control organization is the means by which the objectives of damage control can be attained. In fact, organization is the key to successful damage control. The damage control organization establishes standard procedures for handling various kinds of damage, and it sets up training procedures so that every person should immediately know what to do in each emergency situation.

Both the preventive and the corrective aspects of damage control are vitally important. The preventive aspects of damage control require the efforts of all departments in establishing material conditions of readiness, in training personnel, and in maintaining the ship in the best possible condition to resist damage. To achieve these ends, the ship's damage control organization must be coordinated with other elements of the ship's organization. In each department, therefore, specific damage control duties must be assigned to individuals in each division; this includes the designation of a division damage control petty officer. The corrective (or action) aspects of damage control require the damage control battle organization to promptly restore the offensive and defensive capabilities of the ship.

There are actually two damage control organizations: the damage control administrative organization and the damage control battle organization. The damage control administrative organization is an integral part of the engineering department organization. However, each department has major administrative and preventive maintenance responsibilities which are fulfilled within its normal administrative organization. The damage control battle organization includes damage control central and various repair parties. The damage control battle organization varies somewhat from one ship to another, depending upon the size, type, and mission of the ship. However, the same basic principles apply to all damage control organizations.

## BATTLE ORGANIZATION

The damage control battle organization includes damage control central (DCC), repair parties for hull, propulsion, electronics, weapons, and air, and battle dressing stations. This organization is based on the following principles:

1. Each person within the organization must be highly trained in all phases of damage control along with the technical aspects of his rating field to assist in the control of damage.

2. The organization must be decentralized into self-sufficient units in communications with the others, and be capable of positive action in control of the types of damage likely to be encountered.

3. One central station receives reports from all damage control units, and evaluates and initiates those orders necessary for corrective action from a shipwide point of view. It also reports to and receives orders from command concerning matters affecting buoyancy, list, trim, stability, watertight integrity, and NBC defense measures.

4. Damage control units assigned to work peculiar to a single department are under the direct supervision of an officer of that department.

5. Provision must be made for relief of men engaged in arduous tasks, for battle messing, and for transition from one condition of readiness to another. In this respect, procedures shall be in effect to ensure all relief crews are kept apprised of the overall situation, thereby assuring continual and proper action to combat the casualty.

6. Provision must be made for positive, accurate, and rapid communications between all damage control parties, firefighting parties, or similar groups, so that overall coordination of effort and direction can be readily accomplished.

7. Provisions must be made for the repair party remotely located from DCC to assume the functions of DCC in the event incapacitating battle damage is sustained by DCC.

The battle station for the DCA normally is DCC. The primary damage control battle organization units, shown in Figure 7-1, are repair parties or teams. Battle dressing stations should be provided in close proximity, where appropriate.

Damage Control Central

Personnel in DCC, under direction of the DCA, perform the following tasks:

1. Receive and evaluate information from all repair parties.

2. Inform command of conditions affecting the material condition of the ship, including buoyancy, list, trim, stability, and watertight integrity.

3. Initiate orders to repair parties, as necessary, to direct control of damage.

4. Keep command apprised of progress in combating damage, fire, flooding, the effects of NBC attack, etc., and, when feasible, the extent of significant personnel casualties. Evaluate the necessity of flooding magazines endangered by fire and make recommendations to the commanding officer, and act upon those orders issued by the commanding officer pertaining to the flooding of magazines.

5. Control watertight integrity, flooding, counterflooding, and dewatering.

6. Maintain the following material as described below.

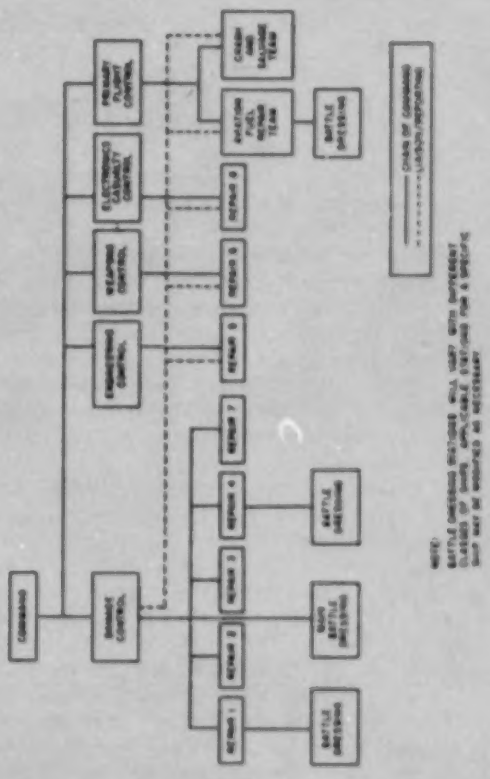


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Figure 7-1.—A typical damage control battle organization.

CHARTS and DIAGRAMS posted and suitably labeled to show the subdivisions of the ship and its systems.

A CASUALTY BOARD posted to show visually the damage sustained by the ship and corrective action in progress, as obtained from reports by repair parties.

A STABILITY BOARD posted to show the liquid loading, the location of flooding boundaries, the effect of list and trim caused by flooded compartments, and the corrective action taken with regard to stability. A liquid loading and flooding effects diagram may best be used for this purpose.

A LIST of ACCESS routes for ready shelter, deep shelter, electronic casualty control, and battle dressing.

GRAPHIC DISPLAYS to show action taken to correct damage control and electrical systems.

DECK plans to indicate areas contaminated by NBC agents, the locations of battle dressing stations, decontamination stations, and safe routes to them.

A CLOSURE LOG to show the state of closure of the ship.

NBC CONTAMINATION PREDICTION PLOT. Provision should be made for an alternate DCC. This station may be one of the repair party stations, engineering control, or secondary engineering control. The station designated must have facilities for fully communicating with all sections of the ship.

A simplified schematic should be maintained on the bridge for visual reference by command on casualty data reported by DCC.

Repair Parties and Teams

Repair party officers take charge of activities in their area of responsibility after damage is sustained, keeping DCC informed of the situation. Certain repair parties may be subdivided, or prescribed functions may be the joint responsibility of two or more repair parties when necessary. When subdivisions of repair parties are created, they are designated by the number of the parent party followed by a letter (e.g., 1-A, 1-B).

COMPOSITION.—The composition of repair parties must permit each party to handle damage and casualties that may occur within its assigned area(s). Each shop shall designate a repair party as secondary DCC; in addition, a complete succession to command of damage control will be promulgated and posted in each repair locker. Physical location of each locker, seniority of repair locker officer, and communication facilities available should be considered in designating succession to command. The following general composition is considered necessary:

REPAIR 1 (MAIN DECK REPAIR PARTY).—An officer or chief petty officer from a deck division is in charge. It is comprised of deck petty officers and nonrated men, storekeepers, radiomen, electrician's mates, hospital corpsmen, and aviation details (except in aircraft carriers). Engineering petty officers may also be required.

REPAIR 2 (FORWARD REPAIR PARTY).—A suitably trained officer or chief petty officer is in charge. The party is comprised of petty officers of the deck and engineering branches, electrician's mates, storekeepers, hospital corpsmen, and nonrated men.

REPAIR 3 (AFTER REPAIR PARTY).—Similar to Repair 2.

REPAIR 4 (AMIDSHIP REPAIR PARTY).—Similar to Repair 2.

REPAIR 5 (PROPULSION REPAIR PARTY).—An engineering department officer is in charge. The party is comprised of an electrical officer or senior electrician's mate and a broad cross section of engineering ratings. Emphasis on assignment of personnel to Repair 5 should be placed on fireroom/engine room takeover qualifications in deference to damage control qualifications.

REPAIR 6 (ORDNANCE REPAIR PARTY.)—An officer or chief petty officer of the weapons department is in charge. The party is comprised of gunner's mates, fire control technicians, and electrician's mates. This party may be divided into forward and after subgroups.

REPAIR 7 (GALLERY DECK AND ISLAND STRUCTURE REPAIR).—A suitably trained officer is placed in charge, and the party is comprised of air, engineering, damage control, and other ratings.

REPAIR 8 (ELECTRONICS REPAIR PARTY).—An officer (EMO) or chief petty officer of the operations department is in charge. The party is comprised of electronics technicians, sonar technicians, fire control technicians, and electrician's mates. This repair party works under electronics casualty control.

AVIATION FUEL REPAIR TEAMS AND CRASH AND SALVAGE TEAMS.—In addition to eight repair parties, there are two repair teams in the air department of aircraft carriers; the Aviation Fuels Repair Team (formerly Repair 7) and the Aircraft Crash and Salvage Team (formerly Repair 8). These two teams consist of personnel highly trained in the maintenance and repair of the aviation fuels systems and aircraft firefighting and personnel rescue. They work in close coordination with, and may be called upon to assist, other repair parties. The hangar deck officer is in charge of Repair 1-H (subdivision 1-H of Repair 1

(Hangar Bays Repair Party)) with an officer or chief petty officer assistant for each hangar bay.

For a detailed description of repair 1-H and the aircraft crash and salvage team refer to chapter 6 of this manual.

ORDNANCE DISPOSAL TEAM. — This team is made up of specially trained personnel deployed aboard ships as required. The team is organized within and administered as a unit of the weapons department. The ordnance disposal team operates under the direction of the weapons officer except as specified in this publication to fit the peculiarities of aircraft carriers.

AT-SEA FIREFIGHTING TEAM. — All ships—less submarines, patrol and yard craft, mine craft, and small auxiliaries—will maintain at least one at-sea firefighting team. Smaller craft and ships whose complement will not permit formation of this team shall organize a fire party as appropriate.

IDENTIFICATION. — Damage control party leaders are issued a steel helmet (or similar headgear) for wear during damage control actions. The words "damage control party leader" are intended to be synonymous with repair party leader or fire party leader. Helmets/liners worn by damage control party (repair party, fire party) leaders are painted red and bear 1-inch black lettering on the front and back identifying the particular damage control party. About the lower circumference of the helmet/liner there is affixed three 1-inch horizontal stripes of reflective tape, alternating white-red-white. Repair party personnel whose duties require them to go topside wear steel helmets. Repair party personnel whose duties are entirely below deck may wear helmet liners in lieu of steel helmets.

On flight and hangar decks of aircraft carriers and other ships operating helicopters or fixed-wing aircraft, the wearing of steel helmets is not in consonance with authorized flight quarters clothing. Accordingly, flight deck helmets will be substituted for the steel helmet where appropriate. Helmets are marked as indicated above. In event cloth helmets are currently authorized, they will continue to be worn by crash/salvage party leaders and the red jersey stenciled with the words "Crash/Salvage Leader."

FUNCTIONS OF REPAIR PARTIES. — General functions of repair parties require that repair parties work in close coordination with each other. The following functions are common to all repair parties:

1. Each party must be capable of making repairs to electrical and sound-powered telephone circuits.
2. Each party must be capable of giving first aid and transporting injured personnel to battle dressing stations without seriously reducing the damage control capabilities of the repair party.
3. Each party must be capable of detecting, identifying, measuring dose and dose-rate intensities from radiological involvement, and survey and decontamination of contaminated personnel and areas that may result, except where specifically assigned to another department as in the case of nuclear weapons accident/incident.
4. Each party must be capable of sampling and/or identifying biological or chemical agents and decontaminating areas and personnel affected as a result of biological or chemical attack, except where the medical department is responsible.
5. Each party must be capable of controlling and extinguishing all types of fires.
6. Each party must be organized to evaluate and report correctly the extent of damage in its area. This will include maintaining the following:

a. Graphic display board showing damage, and action taken to correct disrupted or damaged systems. Standard control symbology is used. Use of the preprinted message format is suggested to facilitate recording transmitted damage control information.

b. Deck plans showing locations of NBC contamination, location of battle dressings and personnel cleansing stations, and safe routes to them.

c. A casualty board for visual display of structural damage.

SPECIFIC FUNCTIONS OF SPECIFIED REPAIR PARTIES. — The following specific functions are the responsibilities of the repair parties indicated.

Maintenance of stability and buoyancy is the responsibility of Repairs 1, 2, 3, 4, and 5. These repair parties must be:

1. Stationed so that they can reach all parts of the ship with a minimum opening of watertight closures.

2. Able to repair damage to structures, closures, or fittings that are designed to maintain watertight integrity, by shoring, plugging, welding, caulking the bulkheads and decks, resetting valves, and blanking or plugging lines through watertight subdivisions of the ship.

3. Prepared to sound, drain, pump, counterflood, or shift liquids in tanks, voids, or other compartments, and be thoroughly familiar with the location and use of all equipment and methods of action.

For accurate evaluation of underwater damage, two status boards should be maintained. The Stability Status Board (Flooding Effects Diagram) is used for visual display of all flooding, flooding boundaries, corrective measures taken, and effects on list and trim. A Liquid Load Status Board is maintained to show the current status of all fuel and water tanks and the soundings of each tank in feet and inches.

Maintenance of ships structural integrity and maneuverability is the responsibility of Repairs 1, 2, 3, and 4. These repair parties must do the following:

1. Make repairs to primary and auxiliary methods of steering.
2. Clear the upper decks of wreckage which interferes with operation of the battery, ship, or fire control stations or which fouls the rudder, propellers, or sides of the ship, and be ready to extinguish all types of fires.
3. Maintain and make emergency repairs to battle service systems such as ammunition supply, ventilation supply, high and low pressure air lines, communications systems, electrical systems, and cooling water systems.
4. Provide emergency power to electrical equipment using casualty power cables.
5. Assist the crash and salvage team as required.
6. Stream and recover minesweeping equipment during general quarters.
7. Rescue survivors from the water, and render assistance to other ships.
8. Repair above-water damage that could cause flooding in the event of further damage.

Maintenance of ships propulsion is the responsibility of Repair 5, which must do the following:

1. Maintain, make repairs, or isolate damage to main propulsion machinery and boilers.
2. Operate, repair, isolate, and modify the segregation of vital systems.
3. Assist in the operation and repair of the steering control systems.
4. Assist in the maintenance and repair of communications systems.
5. Assist Repairs 1, 2, 3, and 4 and the crash and salvage team when required.

Maintenance of ordnance and magazine protection is the responsibility of Repair 6, and includes the following:

1. Emergency repairs to all ordnance installations, including the supply and renewal of parts.
2. Operation of the magazine sprinkler systems and other ordnance systems.
3. Assisting other repair parties in extinguishing fires in the vicinity of magazines.
4. Assisting other repair parties in making hull damage repairs.
5. Stationing repair party control at main forward major and minor caliber magazine sprinkler control station with communications to weapons control, DCC, and own detached units.
6. Notifying DCC of the sprinkling/flooding of magazines.
7. Isolating magazines which are to be sprinkled from others in the same group.

Maintenance of the main deck (and hangar bays in aircraft carriers) is the responsibility of Repair 1 and subdivisions, which have the following duties:

1. Control and extinguish fires.
2. Repair damage in assigned areas.

Maintenance of the gallery decks and island structure in aircraft carriers is the responsibility of Repair 7, which must do the following:

1. Control and extinguish fires.
2. Repair damage in assigned areas.

Maintenance of electronics equipment on selected ships is the responsibility of Repair 8. On ships with highly complex electronic weapons systems, such as missile ships and large aircraft carriers, Repair 8 must be able to do the following:

1. Repair radar, radio, countermeasures, and all associated electronics equipment.

2. Repair fire control equipment.
3. Repair sonar equipment.
4. Extinguish minor electrical fires.

Maintenance of the aviation fuels system is the responsibility of the aviation fuel repair team, which must do the following:

1. Operate, maintain, and repair the aviation fuel systems.
2. Extinguish fires.

Maintenance of the flight deck and hangar deck is the responsibility of the crash and salvage team, which has the following responsibilities:

1. Extinguish aircraft fires, and make expeditious pilot rescue and aircraft salvage operations on the flight deck.
2. Make repairs of all types to the flight deck and associated equipment.
3. Make repairs of all types to hangar deck and associated equipment.

Maintenance of exposed ordnance protection is the responsibility of the weapons officer in conjunction with the air officer who is responsible for this function during flight quarters on the flight and hangar decks. Their principal assistance for this function comes from the ordnance disposal team, which must do the following:

1. Remove ordnance from aircraft on fire, or at any time required.
2. Safety and jettison ordnance as necessary to prevent damage.

SPECIAL ORGANIZATION OF REPAIR PARTIES.—Special organization with regard to stations and functions is indicated below for certain specific types of ships.

REPAIR 5 may be split on larger ships. Each half of the party is assigned one-half of the engineering plant. Maximum use of manpower and equipment, and greater dispersal of personnel may be realized by this arrangement. However, each section of the repair party must be assigned sufficient qualified engineering casualty control and damage control personnel.

AVIATION FUEL REPAIR TEAM AND CRASH AND SALVAGE TEAM.—May be combined in small carriers, or incorporated into existing repair parties on ships equipped for manned helicopter.

REPAIR 5 functions are assigned to the appropriate repair party designated by the type commander on those small ships which do not have a Repair 5.

Battle Dressing Stations

While most ships have a minimum of two battle dressing stations equipped for emergency handling of battle casualties, many smaller ships, such as minesweepers, have only one such station. Ships having two or more battle dressing stations should have the stations well separated from each other and each station accessible to stretcher bearers from repair parties within the vicinity. Each battle dressing station should be manned by medical department personnel as assigned by the senior member of that department. In addition to battle dressing stations, first aid boxes are provided to personnel on battle stations. The medical department furnishes the material for these boxes.

## DAMAGE CONTROL OPERATIONS

### MATERIAL CONDITIONS OF READINESS

Material conditions of readiness refer to the degree of access and system closure to limit the extent of damage to the ship. Maximum closure is not maintained at all times because it would interfere with the normal operation of the ship. For damage control purposes, naval ships have three material conditions of readiness, each condition representing a different degree of tightness and protection. The three material conditions of readiness are called X-RAY, YOKE, and ZEBRA. These titles, which have no connection with the phonetic alphabet, are used in all spoken and written communications concerning material conditions.

Condition X-RAY, which provides the least protection, is set when the ship is in no danger from attack, such as when it is at anchor in a well-protected harbor or secured at a home base during regular working hours.

Condition YOKE, which provides somewhat more protection than condition X-RAY, is set and maintained at sea. It is also maintained

in port during wartime and at other times in port outside of regular working hours.

Condition ZEBRA is set before going to sea or entering port, during wartime. It is also set immediately, without further orders, when manning general quarters stations. Condition ZEBRA is also set to localize and control fire and flooding when not at general quarters stations.

The closures involved in setting the material conditions of readiness are labeled as follows:

X-RAY, marked with a black X. These closures are secured during conditions X-RAY, YOKE, and ZEBRA.

YOKE, marked with a black Y. These closures are secured during conditions YOKE and ZEBRA.

ZEBRA, marked with a red Z. These closures are secured during condition ZEBRA.

Once the material condition is set, no fitting marked with a black X, a black Y, or a red Z may be opened without permission of the commanding officer (through the damage control assistant or the officer of the deck). The repair party officer controls the opening and closing of all fittings in his assigned area during general quarters.

Additional fitting markings for specific purposes are modifications of the three basic conditions, as follows:

CIRCLE X-RAY fittings, marked with a black X in a black circle, are secured during conditions X-RAY, YOKE, and ZEBRA. CIRCLE YOKE fittings, marked with a black Y in a black circle, are secured during conditions YOKE and ZEBRA. Both CIRCLE X-RAY and CIRCLE YOKE fittings may be opened without special authority when going to or securing from general quarters, when transferring ammunition, or when operating vital systems during general quarters; but the fittings must be secured when not in use.

CIRCLE ZEBRA fittings, marked with a red Z in a red circle, are secured during condition ZEBRA. CIRCLE ZEBRA fittings may be opened during prolonged periods of general quarters, when the condition may be modified. Opening these fittings enables personnel to prepare and distribute battle rations, open limited sanitary facilities, ventilate battle stations, and provide access from ready rooms to flight deck. When open, CIRCLE ZEBRA fittings must be guarded for immediate closure if necessary.

DOG ZEBRA fittings, marked with a red Z in a black D, are secured during condition ZEBRA and during darken ship condition. The DOG ZEBRA classification applies to weather accesses not equipped with light switches or light traps.

WILLIAM fittings, marked with a black W, are kept open during all material conditions. This classification applies to vital sea suction valves supplying main and auxiliary condensers, fire pumps, and spaces that are manned during conditions X-RAY, YOKE, and ZEBRA. It also applies to vital valves that, if secured, would impair the mobility and fire protection of the ship. These items are secured only as necessary to control damage or contamination and to effect repairs to the units served.

CIRCLE WILLIAM fittings, marked with a black W in a black circle, are normally kept open (as WILLIAM fittings are) but must be secured as defense against NBC attack.

The closure classifications just discussed apply to all watertight, airtight, firetight, and fumetight access fittings, as follows:

1. X-RAY. Doors and hatches to storerooms and stowage spaces (including cargo ammunition); hatches (if provided with scuttle) to magazine and handling rooms; bolted plate manholes; escape scuttles not noted elsewhere; doors and hatches (on weather deck and below) for striking down stores and ammunition only; aircraft fueling station compartment; doors to escape trunks in machinery spaces; arresting gear machinery room; eductor room; capstan and winch control room; stores elevator; catapult machinery room; doors to forced draft blower rooms; and fan rooms are closed.

2. CIRCLE X-RAY. Doors to magazines and handling rooms; hatches (without scuttle) to magazines and handling rooms; missile handling and checkout area compartment; scuttles in hatches to shaft alley, pump rooms, magazines, and handling rooms; gas and fuel station and filter rooms; oxygen-nitrogen rooms (compressor and producing); switch gear room, ammunition hoist and elevators; underwater log room; equipment rooms that are unoccupied; scuttles for passing ammunition; and dash hangar are closed.

3. YOKE. Hatches (if provided with scuttle) to shaft alley and pump room; alternate access to machinery spaces; weather deck hatches not classified X-RAY; some alternate access on DC deck and above; windlass room; generator rooms; air compressor room; air conditioning machinery room; refrigeration machinery room; elevator machinery room; missile director room; chain locker; and drying room are closed.

4. CIRCLE YOKE. Hatch (without scuttle) to shaft alley and pump room; scuttle in deck to shaft alley and pump room; door at bottom of trunk to shaft alley and pump room; steering gear power and ram room; and chill room are closed.

5. ZEBRA. All remaining doors and hatches for routine access; all shops, labs, commissary, utility, control, and hospital spaces; all offices, equipment rooms occupied when associated control room is in use; main access to machinery spaces; issue rooms; steering gear room; enclosed operating station; hangar and flight deck control station; garbage disposal room; and trash burner and bin room are closed.

6. CIRCLE ZEBRA. Limited doors or scuttles from weather deck to crews galley; and doors from aviators and flight crew ready rooms to flight decks are closed.

7. DOG ZEBRA. Weather access doors (excluding those classified X-RAY and YOKE) not equipped with darken ship switch or light trap are closed.

8. CIRCLE WILLIAM. Pilot house and flag bridge doors are closed.

If access to a space is by way of a series of hatches and/or scuttles, then these additional fittings must be classified to provide the same material condition as the space. An example of this condition is a pump room classified CIRCLE YOKE. This means it is opened during condition X-RAY and closed during condition YOKE. Hatches, scuttles, and/or doors that provide access to the pump room must also classified as noted for the space in question. When a fan room door must be kept open for supplying or exhausting air to a fan, it should have the same classification as the fan—for example, YOKE fan, YOKE door; YOKE and ZEBRA fans, ZEBRA door. All other fan room doors are X-RAY.

Classification has no bearing on the security of a space. A space classified ZEBRA may, for security reasons, be locked during condition YOKE if the space is unattended. However, the locking must be reported to the DCA or to the OOD.

In setting material conditions of readiness, living conditions and access to spaces must naturally be secondary to the requirements for watertight, airtight, firetight, and fumetight integrity. However, long periods of immediate readiness for action may require that condition ZEBRA be modified so that food may be prepared and distributed and so that sanitation facilities may be used, while still keeping the ship essentially in the material condition for action. The commanding officer may authorize modifications of condition ZEBRA when the reduction in protection is consistent with the tactical situation. Fittings to be opened and systems to be operated should be kept to a minimum and must be guarded so that the original condition may be restored quickly Condition ZEBRA (modified) is established to denote this state of readiness. Modified condition ZEBRA provides a degree of watertight, airtight, flametight, and fumetight integrity greater than that of condition YOKE but less than that of condition ZEBRA. Condition YOKE may also be modified in a similar manner when appropriate to the situation.

## COMPARTMENT CHECKOFF LISTS

A compartment checkoff list is permanently posted in each compartment; a master copy of each list is kept in damage control central. The compartment checkoff list is an itemized list of all hatches, doors, valves, and classified fittings in the space that are used in damage control for setting material conditions of readiness. The list shows the name, location, purpose, and classification of each fitting and states who is responsible for its proper closure.

If a compartment has two or more entrances, it may be desirable to post one or more duplicate checkoff lists; these lists should be clearly labeled DUPLICATE. If a compartment includes alcoves or spaces, it may be desirable to have partial checkoff lists posted in the alcoves or spaces; these lists should be clearly labeled PARTIAL. The item numbers on these partial lists must correspond with the numbers on the main list. Checkoff lists should always be as specific as possible.

The damage control assistant (DCA) is responsible for posting compartment checkoff

lists and for seeing that the lists are correct. He is also responsible for making alterations to the lists when required.

Each division officer is responsible for maintaining the compartment checkoff lists in good physical condition. However, the division officer is NOT responsible for correcting the lists.

The commanding officer is responsible for filling in the column marked DIVISION RESPONSIBILITY.

Setting the closure of X-RAY and YOKE fittings is the responsibility of the division concerned. Setting the closure of ZEBRA fittings is the responsibility of the repair parties.

## CLOSURE LOGS

Strict discipline must be maintained in connection with the modification of material conditions of readiness. Before a material condition setting is altered in any way, permission must be obtained from damage control central or from the officer of the deck. The repair party officer controls the opening and closing of all fittings in his assigned area during general quarters.

A closure log is maintained at all times in port and underway to show (1) where the existing material condition setting has been broken; (2) the number and types of the fittings, as well as their classification; (3) the name, rate, and division of the person who requested permission to open or close the fittings; and (4) the date and time the fittings were opened or closed and later returned to their material condition setting. The commanding officer prescribes the limit to which the breaking of watertight integrity may be approved by damage control central or by the OOD. It is just as important to report the temporary closing of a fitting that should be open as it is to report the opening of one that should be closed. As an example, a ZEBRA hatch that is dogged when general quarters is sounded could impede the movement of men to their battle stations.

## CARE OF CLOSURES AND FITTINGS

Maintaining watertight integrity requires that all closures and fittings be maintained in topnotch condition at all times. Lack of tightness in closures and fittings could be extremely dangerous and could even lead to the loss of the ship.

Faulty gaskets are a source of leakage through closures. Rubber gaskets are installed in doors, hatches, scuttles, and dogged manholes to provide a tight all-round fit. Exposure to oil, grease, heat, or paint causes deterioration of the gaskets. Gaskets should be protected from exposure to deteriorating substances or conditions and replaced immediately when they show signs of deterioration. They should also be inspected frequently to detect hardness, cracks, or permanent set greater than 1/8 inch.

Gaskets used with bolted manhole covers and other bolted plates are of a different type than those used with doors, hatches, scuttles, and dogged manholes. The gaskets used with bolted manhole covers and similar bolted plates should be renewed whenever they are found to be in poor condition when the cover is removed. Replacement of these gaskets is particularly important because you can't tell anything about the condition of the gasket when the plate is bolted down. The gasket may appear to be perfectly all right when it is actually in poor condition and providing a channel for progressive flooding. The replacement gaskets must be of the proper material. The bolts must be set up tightly and evenly all around. A loosely secured cover can be blown off by an explosion that would not remove a cover that is tightly secured.

Knife edges and bearing surfaces may be distorted by impact of heavy objects when ammunition or other heavy material is carelessly handled as it is being moved through doors and hatches. Ship's personnel must be trained to avoid damaging the knife edges and bearing surfaces.

The compression between a knife edge and a gasket should be checked from time to time and adjusted, if necessary, in order to have the compression specified in the manufacturer's technical manual.

Watertight doors and hatches will retain their efficiency longer and require less maintenance if they are properly closed and opened. When you close a door or hatch, first set up a dog that is on the OPPOSITE SIDE from the hinges, with just enough pressure to keep the door shut. Then set up two dogs snugly on the hinge side, and finally set up all the remaining dogs evenly to ensure an even bearing all around. When you loosen dogs on watertight doors or

hatches, loosen the ones nearest the hinges first; this keeps the door from springing and makes it easier to operate the remaining dogs.

A common point of leakage is around dog spindles, in areas where the spindles pass through door frames. There is a stuffing box for each dog spindle. The packing in the stuffing box prevents leakage. The stuffing boxes should be inspected frequently to make sure they are in good condition. The packing gland should be tightened to give correct compression of the packing. Dogs should be repacked when the packing has hardened or otherwise deteriorated with age. Dogs should be adjusted occasionally to accommodate for the wearing down of the wedges against which they bear. In addition, wedges may have to be built up or replaced when they become badly worn.

For a door or hatch to be watertight when it is dogged, the knife edge or bearing surface must be well centered on the gasket and must bear firmly and evenly all around. This condition cannot be achieved if either the door or the frame is warped or if the door or hatch is not located correctly on its hinges with respect to the frame. Knife edges must be straight and even, retainer strips must be firmly secured in place, and the dogs must be adjusted to provide equal pressure on all wedges when the dogs are set up. Incorrect fit of any of these parts may allow the frame or knife edges to come in contact with the metallic parts of the closure and thus allow the door to be closed in a nonwatertight condition.

Some gasketed covers provided for the ends of ventilation ducts are subject to the same kinds of failure as access closures. Many ventilation closures and valves installed in the ducts are subject to lack of tightness caused by improper seating. Improper seating results, in turn, from dirt in the ducts, corrosion, or failure of the operating gear. These fittings should be inspected frequently and given routine lubrication and upkeep in order to keep them in good working order.

## CHECKING WATERTIGHT INTEGRITY

Although watertight integrity features are built into naval ships, regular checking is maintained. Some watertight integrity tests are scheduled under the 3-M System.

Visual inspection of watertight bulkheads and decks frequently turns up leaks that should be repaired. If a compartment contains oil, water, or other liquid, any leakage will be evident. In dry compartments, loose rivet heads, poorly calked plate laps or stiffeners, and poorly calked bounding angles may indicate that the compartment would leak if flooded. All leaks should be repaired as soon as possible. If the repairs are beyond the capacity of ship's force, the repairs should be requested for accomplishment at the next shipyard, tender, or repair ship availability.

A special type of visual examination is made at specified intervals by completely closing and darkening the compartment to be inspected, stationing an observer in the darkened compartment, and lighting up adjacent compartments. As a rule, the light from the surrounding compartments will be sufficient to allow the observer to note any serious defects. In some cases, it may be necessary to use portable lights to provide a higher level of illumination.

Visual inspection with the compartment darkened is particularly important for those compartments that cannot be tested by air pressure because of the existence of permanent openings to the topside. Compartments listed for this type of visual examination include enginercoms, firerooms, or other machinery spaces, and all compartments on the main deck and above.

# CHAPTER 8

# ADMINISTRATION

By definition a supervisor is one who is responsible for and directs the work of others. This means that the leading AB must actually oversee and instruct the men under his supervision. A mere inspection of the accomplished work is not supervision. The function of supervision is not considered to have been fulfilled until positive action has been taken to improve a program, to expedite a process, or otherwise improve a given situation. The supervisor has a tremendous responsibility when all facets are considered. He must satisfy the demands of his superiors, he must keep his men busy and content in their work, and as a check on himself, must constantly analyze his abilities in the job to determine if he is successfully accomplishing the goals of an instructor, leader, and administrator.

## MANAGEMENT OF SHOP AND PERSONNEL

As an ABH1 or ABHC, you will have new supervisory duties which will require a greater knowledge and ability in administrative duties and procedures. The job of supervising is a many-sided task. It involves the procurement of equipment, repair parts, and other necessary materials; planning, scheduling, and directing work assignments; maintaining an adequate file of applicable references and technical manuals/publications; maintaining the required logs and records; making reports; and carrying on an effective and scheduled training program.

Some typical duties and responsibilities are as follows:

1. Getting the right man on the job.
2. Using and placing materials economically.
3. Preventing accidents and controlling hazards.
4. Keeping morale at a high pitch.
5. Maintaining quality and quantity of work accomplished.
6. Maintaining accurate and up-to-date records and reports.
7. Maintaining discipline.
8. Planning and scheduling work.
9. Procuring tools and equipment to do the work intended.
10. Giving orders, making decisions.
11. Checking and inspecting jobs of men.
12. Promoting good teamwork.

Some of the above techniques will have been learned through past experience; others will have to be learned during the actual supervision of the division. Still other techniques may be learned from self-study courses and technical publications. The purpose of this chapter is to acquaint the new supervisor with some of the more important aspects of supervision.

Briefly, the objectives of shop supervision are as follows:

1. To operate with maximum efficiency and safety.
2. To operate with minimum expense and waste.
3. To operate free from interruption and difficulty.

Personnel that are under your supervision must always be made aware of the dangers involved while working around the machinery or the aircraft aboard a carrier. They must move quickly, efficiently, and safely.

While these are the primary objectives of supervision, it is well for the ABH1 or ABHC who may be assigned these duties to keep in mind the fact that his assignment is important to him personally. It affords him an excellent opportunity to gain practical experience toward eventual advancement to ABCS and ABCM.

A supervisor should know his men's limitations and capabilities in order to get the most work out of them. He should utilize the capabilities of his best men in a twofold manner. If at all possible he should assign a well-qualified man to do a certain job and add to the team other individuals who are less qualified, but who are professionally ready for advanced on-the-job training.

The supervisor must anticipate the eventual loss of his most experienced workers through transfers, discharges, etc., and offset this by the establishment of an effective and continuing training program. In addition to raising the skill level of his division, the training program will ensure that personnel, otherwise qualified, will be ready for the advancement examination.

A safety program must be organized and administered if the division is to function efficiently. Current Navy directives and local policies are quite specific as to the establishment of safety training programs. A worker is not much good to anyone if he is laid up in the sickbay.

The keeping of accurate and complete records is another factor in the efficient operation of a division. This includes records of usage data, work accomplished, and personnel progress. The most efficient recordkeeper is one who has enough records without having his files bulging with useless and outdated material.

The supervisor has responsibility for ordering and accounting for spare parts and material. He must impress upon his men the need for being thrifty in the use of these materials. The efficiency of any operation is directly related to the relative expense involved. There are many ways to economize, and the supervisor and his senior petty officers should always be on the alert for opportunities to point out these ways to the less experienced individuals.

Methods of avoiding waste and unnecessary expense should be included in the training program.

## MAINTENANCE SHOP

A smooth running maintenance program depends largely upon the extent to which the maintenance shop files and equipment are maintained. Equipment in good working order, tools in good shape and of the proper type and quantity, and an up-to-date file of applicable publications are all important factors indicating a smoothly run maintenance shop.

The shop functions may be further smoothed by the judicious delegation of authority to individuals next in seniority to the supervisor. The delegation of authority does not relieve the supervisor of the final responsibility for work accomplishment. It is primarily a means of relieving the supervisor of details. A supervisor who allows himself to become too involved with details loses his effectiveness as a supervisor.

A system of stowing tools must be devised. An efficient system cannot be set up without first determining from allowance lists what tools will be required for satisfactory operation of the shop. The place for all tools should be marked or otherwise specified, and those not being used should be kept in that place.

The shop layout plan should make provisions for an information or bulletin board upon which may be posted safety posters, maintenance posters, instructions and notices, plans-of-the-day, and such other information as is appropriate from time to time. The bulletin board should be located in a prominent place in the shop, preferably near the entrance where everyone assigned will have to pass it at some time during the day. Material on the bulletin board should be changed frequently, expired notices promptly removed, the current plan-of-the-day posted early, and other posters and material rotated periodically. If the same material is presented in the same format every day, it will not be too long before the men begin to ignore the bulletin board and the purposes for having it will have been defeated. New arrangements are noticed, and interest is stimulated with variety.

## PERSONNEL WORK ASSIGNMENTS

Work assignments should be rotated so that each man will have an opportunity to develop his skills in all phases of the ABH work. When assignments are rotated, the work becomes more interesting for the men. Another good reason for rotating work assignments is that if one highly skilled man performs all the work of a certain type, the supervisor and the division would be at a great disadvantage in the event the man is transferred. Less experienced personnel should be assigned to work with him in order to become proficient in his particular skill. Also, to broaden his knowledge of his rate, the expert on one job should be rotated to

other tasks. This will make him more valuable to his division and to the Navy in general.

Strikers should be assigned to various tasks so that they will acquire experience on all kinds of jobs. A special consideration for the assignment of strikers to jobs is that they should be assigned progressively to jobs of ascending levels of difficulty. A striker may be a useful assistant on a complicated job, but he may not understand what he is doing unless he has worked his way up from basic tasks.

## ALLOWING FOR PLANNED INTERRUPTIONS

During an average workday, occasions will arise when personnel have to leave their working spaces for one reason or another, thereby delaying the completion of the scheduled work. Some delays can be anticipated; some cannot. Among the delays which can be anticipated are training lectures, immunization schedules, flight operations, rating examinations, meals, and watches or other military duties.

Before making personnel work assignments, the supervisor should determine what delays can be anticipated. It may be possible to arrange assignments so that work interruption is held to a minimum. When estimating the completion time of a maintenance task, the supervisor should allow for these predictable delays.

## INSPECTION OF COMPLETED WORK

All work completed by the division is subject to inspection. This fact in no way relieves the supervisor of the responsibility for checking on the quality of work accomplished by his division. Frequent inspections should be made during the progress of the work as well as after completion. The supervisor's inspection should provide affirmative answers to the following questions:

1. Is the work being done according to current directives?
2. Do the materials used conform to specifications?
3. Is the job complete in all respects?
4. Does the workmanship measure up to desired standards?

## SETTING UP SAFE WORKING CONDITIONS

Operational readiness of aircraft handling equipment, emergency gear, and firefighting gear is a prerequisite before and during flight operations. Keeping all machinery and/or equipment in "4.0" operating condition is the prime maintenance function of all personnel in the ABH rating. It is equally essential that this important maintenance be performed without injury to personnel or damage to equipment or aircraft, etc.

Maintenance is, to some extent, naturally hazardous due to the nature of the work, the equipment and tools involved, and the variety of materials required to perform many repairs and maintenance functions. Factors which can function to increase or decrease these hazards are (1) the experience levels and mental attitudes of assigned personnel, and (2) the quality of supervision of the maintenance tasks. Thorough indoctrination of new personnel and a continuing safety program are the most important steps in maintaining safe working conditions.

The concept of maintenance safety should extend beyond concern for injury to personnel and damage to equipment. Safe work habits go hand-in-hand with flight operation safety. Tools left adrift, improper torquing of fasteners, and poor housekeeping around machinery can cause conditions which may claim the lives of personnel as well as cause strike damage to aircraft. Safety in machinery spaces is equally as important as safety on the flight deck.

While the increased complexity of our modern equipment is a factor, it is noted that a large number of accidents and incidents are due, not to complexity of equipment, but to lack of supervision and technical knowledge. Many mistakes are simple ones in routine maintenance.

Safety in maintenance depends largely upon the supervisory personnel. The standards of quality which they establish are directly reflected in the quality of the preventive maintenance. The primary duty of the senior petty officers is to supervise and instruct others rather than to become totally engrossed in actual production. Attempts to perform both functions invariably result in inadequate supervision and greater chance of error. Supervisors must exercise mature judgment when assigning personnel to maintenance jobs. Consideration must be given to each man's experience, training, and ability.

Sometimes overlooked in a maintenance program are the considerations generally grouped under the term "human factors." These factors are important in that they determine if an individual is ready and physically able to do the

work safely and with quality. Supervisory personnel should be constantly aware of conditions such as general health, physical and mental fatigue, unit and individual morale, training and experience levels of personnel, and other conditions which can contribute in varying degrees to unsafe work. Not only is it important that proper tools, protective clothing, and equipment are available for use, but also the insistence by maintenance supervisors that they are used is of utmost importance. For example, maintenance personnel are sometimes negligent in the wearing of sound attenuation devices in high noise areas.

Technical knowledge also plays a large part in a good maintenance safety program. The complexity of our modern equipment demands the attention of well-informed and expert maintenance personnel; otherwise, the machinery cannot be operated and maintained properly. Technical knowledge is a function of education and training which, incidentally, does not end with graduation from school. Graduation is only the beginning. Any ABH worthy of the rating is continually training and learning through self-study and application, and through a personal desire for proficiency and self-betterment. Technical knowledge by itself is not sufficient unless it is coupled with an oldfashioned craftsmanship that receives gratification and keen satisfaction in doing any job well. The ABH who wishes to contribute to safety and reliability improvement must know his job and must develop professional pride in the quality of his work.

It is a continuing duty of every person connected with maintenance to try to discover and eliminate unsafe work practices. Accidents which are caused by such practices may not take place until a much later date, and their severity cannot be predicted. The consequences may range from simple material failure to a major accident resulting in serious injuries or fatalities.

There are several areas in which the shop supervisor can effectively work to minimize accidents due to maintenance. Among these are continuing inspections of work areas, tools, and equipment; organization and administration of safety programs; correct interpretation of safety directives and precautions; and energetic and imaginative enforcement of them.

## INSPECTION OF WORK AREAS, TOOLS, AND EQUIPMENT

Most accidents can be prevented if the full cooperation of ALL personnel is gained and vigilance is exercised to eliminate all unsafe acts. The supervisor should continually and diligently inspect work areas, assigned cleaning spaces, tools, and equipment to detect and correct potentially and/or hazardous and unsafe conditions. The ABH may be working in a shop, his assigned cleaning station, or on the flight deck—all of these areas should be included in the supervisor's inspection. He should check for explosion and inhalation hazards due to improper ventilation of working spaces in the event of careless and improper handling of materials.

Fire hazards present another serious problem; "NO SMOKING" rules must be strictly enforced. Spilled fuel, oil, grease, and chemicals must be wiped up promptly, and the rags used disposed of in approved containers or as directed by local regulations concerning flammables.

Handtools should be in good condition, of the proper type, and used only for the purpose intended.

Ensure that equipment is operated only by qualified personnel, and that safety devices and guards are installed and in good condition. The equipment must also be inspected for broken or damaged components, and corrective action taken when required. Check to see that periodic maintenance, servicing, and/or inspections are up to date for that equipment requiring action.

## ORGANIZATION AND ADMINISTRATION OF SAFETY PROGRAMS

In accordance with the Navy policy of conserving manpower and material, all naval activities are required to conduct effective and continuous accident prevention programs. The organization and administration of a safety program are part of the requirements of the supervisor. The safety program must be in accordance with local instructions and based on information contained in official United States Navy safety precautions. Work methods must be adopted which do not expose personnel unnecessarily to injury or occupational health hazards. Instructions in appropriate safety precautions are required, and disciplinary action should be taken in cases of willful violations.

The shop safety program will generally involve three areas of attention—the posting of the most important safety precautions in appropriate places, the incorporation of safety lessons in the formal training program, and

frequent checks for understanding during the day-to-day supervision of work.

Posted safety precautions are more effective if they may be easily complied with. For example, a sign on a tool grinder reads "goggles required," so one or more pairs of safety goggles should be hanging within reach at the machine. Similarly, the protective clothing poster in the shop should be backed up with readily available aprons, gloves, shields, etc.

Fixed posters and signs should be renewed frequently and not allowed to become rusty, faded, or covered with dust and dirt. General safety posters on bulletin boards and other places should be rotated often to stimulate interest.

The formal safety training sessions should utilize films, books, visual aids, or any other suitable technical material. The men should be told more than just what to do or what not to do. Each safety subject should be explained in detail. Causes of accidents and contributing factors should be reviewed and analyzed. Many good ideas for accident prevention have been developed in training sessions devoted to such analysis.

It may be well to mention the new man in the division at this point. A separate safety indoctrination lesson which covers all the major hazards of the work should be given to a new man as soon as he reports for work. No supervisor will expose the new man to air operations without pointing out the dangers involved.

In the third area of safety program administration—follow-up—the supervisor will do well to delegate authority to his subordinate petty officers to assist him in monitoring the program. Also included in the followup area is the responsibility of the supervisor to inquire as quickly and thoroughly as possible into the circumstances of accidents and reports of unsafe practices followed by appropriate action to correct any deficiencies uncovered.

## SUPPLY

It is essential that the ABH1 and ABHC know certain phases of supply in order to procure and maintain equipments in accordance with current regulations. They must be familiar with the publications used in identifying material, equipment, and spare parts utilized in the performance of the duties of their rate. In addition, the ABH1 and ABHC must be familiar with the quantities of material and equipment authorized, and the authorization for these allowances. They must also know procedures used in procuring, expending, inventorying, and maintaining custody of material.

### IDENTIFICATION OF SPARE PARTS AND EQUIPAGE

In order to procure the desired material or to properly conduct an inventory of materials on hand, the ABH must be able to identify the material or equipment concerned. The nameplate attached to some equipment furnishes data helpful in identifying the equipment. However, when procurement requests are initiated, it is very important that the correct national stock number, complete nomenclature, part number, and reference be furnished the supply officer to prevent ordering unsuitable material. This information can normally be obtained from Navy stock lists and applicable technical manuals, parts lists, NAVAIRSYSCOM change bulletins, and allowance lists.

### FLEET ORIENTED CONSOLIDATED STOCK LIST

The Fleet Oriented Consolidated Stock List (FOCSL) is prepared by the Navy Fleet Material Support Office and is designed to afford relief of workload for shipboard personnel. The many stock catalogs are impractical for shipboard use because they are bulky in size, they differ in format, they include much data never used aboard ship, and they require an excessive amount of time to maintain. The FOCSL was developed in order to substantially reduce the number of supply catalogs required to be maintained by reducing and tailoring catalog information to those items of interest to Navy personnel.

Prior to the development of the FOCSL, it was necessary to search through several cross-reference listings published by the various inventory managers to cross-reference a manufacturer's part number of a national stock number. Part numbers for Navy interest items are now consolidated into the MASTER CROSS-REFERENCE LIST section of the FOCSL regardless of the controlling inventory manager. This section is a one-way listing from part numbers to National Item Identification Numbers (NIINs) and includes the national supply code for manufacturers. The part numbers are arranged in alphanumerical sequence.

Bimonthly CHANGE BULLETINS are published to update the Price and Management Data section and the Master Cross-Reference List section; a separate bulletin is issued for each. These change bulletins are cumulative and list necessary current information to update the applicable FOCSL sections. The information is presented in the same format as the basic section.

CURRENT WEAPONS EQUIPMENT LIST (WEL 1090)

This list contains NSN (National Stock Number) to P/N (Part No.) and P/N to NSN cross-reference listings. This list is invaluable to the ABH.

NAVY STOCK LIST OF AVIATION SUPPLY OFFICE

The Navy Stock List of the Aviation Supply Office lists and identifies material under the inventory management of the Aviation Supply Office (ASO). This material is identified by the cognizance symbol E or R prefixing the national stock number of the item. The Navy Stock List of ASO is published in four parts.

Cross-Reference C0009 (NSN to Manufacturer's Part Number and Code)

One part of the ASO stock list publication is a cross-reference from national stock numbers to manufacturer's part numbers and code.

Price and Management Data Section

The second ASO stock list publication contains the following information: the national stock number of the item, its unit price, unit of issue and accountability code; new items; and deleted items. All classes of material are included in these sections.

Descriptive Sections

The third ASO stock list publication contains a cross-reference from the characteristics of items to the national stock numbers.

Parts List Sections

The fourth ASO stock list publication contains a cross-reference from part number to stock number; supersedure of numbers, additional model applications, equivalents, change of design information, maintenance and overhaul percentages; accountability codes, perishability and salvageability information, and indications as to whether items are included on the allowance list.

REQUEST FOR ISSUE

The ABH may encounter a variety of local requisitioning channels, all designed to satisfy material requirements. Procedures at the consumer level are somewhat flexible. Normally, the single line item requisition, DD Form 1348, is the form on which material is procured from the supply department. It is important that the correct stock number, manufacturer's part number, and nomenclature be included on all requests in order to expedite identification and issue. Incorrect or omitted information can lead only to confusion and delay in issue, or possibly the wrong part or material may be issued.

Afloat, the request document is presented to the aviation stores division for technical aeronautical material or to the supply office for other than aeronautical material. While individual ships may employ different procedures; such as a credit card system, the DD Form 1348 is normally the request document. When it is necessary for the ABH to draw parts or material from supply, he prepares a DD Form 1348 and presents it to the air officer or his authorized representative for signature. The DD Form 1348 is then presented to the supply department for processing and receipt of material.

Ashore, the requisition may be presented directly to a supply warehouse or to an established retail issue outlet. Procedures may differ between shore stations, because of assigned levels of maintenance, geographical location of shops relative to supply facilities and other factors. Normally the DD Form 1348 is the proper request document which is prepared and submitted in accordance with local instructions.

REQUESTS FOR IN-EXCESS MATERIAL

Aboard ship requisitions for the following are considered as in-excess:

1. Equipage not on the ship's allowance list.
2. Equipage on the allowance list but in greater quantities than allowed.

3. Repair parts not listed with quantities in ship's allowances for which a request can be justified.

Request for in-excess material must be accompanied by a complete justification as to why the item is required and why authorized material will not suffice. If the item is required for use by all similar type activities, a recommendation should be made to include the item in an applicable allowance list. Except in an emergency, in-excess material cannot be issued by the supply officer until the request has been approved by competent authority.

Ashore, the ABH is not normally confronted with in-excess requirements. Accountable (plant account) material requirements are included in the activity's budget submission to the management bureau, and the granting of funds normally constitutes approval of the requirement.

## REQUESTS FOR NONSTANDARD MATERIAL

Nonstandard material is material for which a national stock number has not been assigned. When preparing a DD Form 1348 for nonstandard material, it is imperative that complete information be furnished in order that the supply officer may positively identify the exact material, equipment, or part that is required. The following information should be furnished, if possible, when requesting nonstandard material:

1. Complete name of item.
2. Complete nomenclature of item.
3. Manufacturer's name.
4. Manufacturer's part or drawing number.
5. Name and address of a dealer where the material can be obtained.
6. The document or publication authorizing issue of the item.
7. Justification as to why standard material will not suffice.

Requests for nonstandard material are prepared on DD Form 1348 and forwarded to the supply officer in the same manner as a request for standard material.

## SURVEYS

The Survey Request, Report, and Expenditure (NAVSUP Form 154) is the document used to reevaluate or expend lost, damaged, deteriorated, or worn material from the records of the accountable officer as required by U. S. Navy Regulations. Rules and regulations governing surveys and the responsibility connected with the accounting for government property are of primary importance to every man in the naval service.

The survey request provides a record showing the cause, condition, responsibility, recommendation for dispostion, and authority to expend material from the records. Rough survey requests are prepared by the person or department head responsible for the material to be expended or reevaluated.

### TYPES OF SURVEYS

There are two types of surveys with which the ABH should be familiar—formal and informal. Each activity normally prepares local regulations outlining the circumstances which will determine whether a formal or informal survey will be made. However, the commanding officer will order a formal survey in any case he deems necessary.

#### Formal Survey

A formal survey is required for those classes of materials or articles so designated by the bureau or office concerned, or when specifically directed by the commanding officer. A formal survey is made by either a commissioned officer or a board of three officers, one of whom, and as many as practicable, must be commissioned, appointed in either instance by the commanding officer.

Neither the commanding officer, the officer on whose records the material being surveyed is carried, nor the officer charged with the custody of the material being surveyed, may serve on a survey board.

#### Informal Survey

Informal surveys are made by the head of the department having custody of the material to be surveyed. Informal surveys are used in cases when a formal survey is not required or directed by the commanding officer.

### PREPARATION OF A REQUEST FOR SURVEY

A request for survey may be originated by a department, division, or section head, or a

designated subordinate, as prescribed by local regulations. Normally, requests for survey are originated in the department having custody of the material being surveyed. The initial survey is made on a rough copy of Form 154. A statement by the originator is placed on or attached to the request for survey. Included in this statement is information relative to the condition of material; cause or condition surrounding the loss, damage, deterioration, or obsolescence of material; responsibility for cause or condition of material, or reason why responsibility cannot be determined; and recommendation for disposition of material or action to be taken.

Upon receipt of the rough copy, the designated group or section prepares a sufficient number of smooth copies of the request for distribution in accordance with local regulations. The smooth survey request is filled in down to the caption "Action by Commanding Officer or Delegate." It is then forwarded to the commanding officer who will determine whether the survey will be formal or informal. If formal, the survey request is forwarded to the designated surveying officer(s); if informal, it is forwarded to the HEAD of department for survey action.

The statement by the originator as to the cause, condition, etc., is attached to the smooth request for survey for evaluation by the surveying officer(s). After the survey has been completed by the head of department or surveying officer(s), it is returned to the commanding officer for review action. After approval by the commanding officer, the survey request is forwarded to the cognizant fleet command and/or bureau for final review and approval when so required. In the absence of specific instruction, surveys are not forwarded to the Naval Air Systems Command for final review and approval.

After approval, the supply officer expends items as directed by the approved survey.

Requests for replacement of surveyed items must be made with DD Form 1348, and must be accompanied by a certified copy of the approved survey request.

## CULPABLE RESPONSIBILITY

When a person in the naval service is found to be culpably responsible by a surveying officer or board, the reviewing officer will refer the entire matter to such a person for a statement. The reviewing officer must then take such disciplinary action as the circumstances require. He will note on the survey the action taken and inform the Chief of Naval Personnel and the bureau concerned as to the disciplinary action taken. In the case of officers, he must make recommendations as to the inclusion of a statement of the action taken in the record of person concerned and inform that person of the final decision in the matter. Action on the survey in respect to the material involved must NOT, however, be withheld pending disciplinary action. (See art. 1953, U. S. Navy Regulations.)

## INVENTORIES

In the first quarter of each fiscal year an annual inventory of equipage is conducted. The supply officer coordinates and sets up the beginning and ending annual inventory dates with the approval of the commanding officer. Each department is advised of these inventory dates in writing by the supply officer. It is the responsibility of each department head to inventory the equipage assigned to his department. ABHs are normally required to physically inventory all equipage assigned to them on a custody receipt from the air officer or their division officer. When equipage is inventoried, special care should be taken to note if it is serviceable, properly preserved and stowed, and to ascertain if it is still required by the department to perform its assigned mission. The using ABH is the person in the best position to determine this. Therefore, he should make recommendations to the division officer or to the air officer as to the need for survey, expenditure, disposition, or acquisition of additional equipage.

The most important inventory is the one held within the division. There is no answer in the event a certain spare part is needed and it suddenly comes to light that one is not available. Not one piece of equipment under the cognizance of ABHs can be allowed to be inoperative at any time. Therefore, if something is in a down status due to the lack of a proper inventory of spare parts, someone is in trouble; and as a senior ABH, there is no need to point out who it is.

To operate efficiently and to ensure that spare parts are properly stowed and inspected, an inventory is held every 30 days. There should always be a 90-day supply of spare parts aboard; therefore, inspect your spares as often as necessary to see that you have a complete stock and that it is in good condition.

## CUSTODY CARDS

Equipage is the term normally used to identify nonexpendable material for which custodial responsibility is designated by means of custody cards. An inventory count of equipage on hand must be brought into agreement with the amount shown on the custody cards. Any items missing at inventory, or found to be unserviceable, must be surveyed and expended from the custody record cards. Equipage, on which custody cards must be maintained, is defined as those items having an accountability code designation of D, E, R, or L. Code D and E items are maintained on a custodial signature basis. Code R and L items, depending on the use of the item, are in some cases maintained on a custodial basis. All of these four coded items are normally exchanged on an item-for-item basis. There are two designations of custody record cards, NAVSUP Form 306 or 460. Figures 8-1 and 8-2 illustrate the two custody cards in current use. Form 306 is being phased out slowly, and Form 460 will eventually replace it.

Equipage is issued by the supply officer to the head of the applicable using department. The department is held accountable to the commanding officer for this material. It is apparent that the head of a department cannot personally keep track of all equipage for which he is held accountable. Therefore, he must delegate custodial responsibility to the division officers and/or leading petty officers using or having the material in their custody. When an ABH is assigned custodial responsibility, he is required to sign a memorandum receipt to his division officer or department head for the material for which he is held responsible.

The ABH should keep strict control over and know the location of his equipment at all times. He can be held culpably responsible for material lost or damaged due to his negligence.

## TECHNICAL PUBLICATIONS

Technical publications that the ABH need be knowledgeable of for use in conjunction with the operation, preoperational inspection, and normal maintenance of aircraft handling equipment are usually in the form of manual-type publications. It is extremely important that senior petty officers be familiar with these publications to enable them to supervise the proper use, filing, procurement of needed manuals, and normal maintenance of these publications.

Technical data indexing is accomplished using several forms. The Naval Supply Systems Command (NAVSUP) issues the stock list of technical data that is prepared and issued under the cognizance of NAVAIR. This stock list is identified as NAVSUP 2002, Navy Stock List of Publications and Forms. The stock list consists of a printed paper-type introduction and stock listings that are in microfiche form (microfiche, at the time of this writing, is an improved method of presenting many pages of printed paper-type information on a single photo negative card that can be viewed by utilizing magnification reading equipment).

The stock list contains listings of the NAVAIR technical manuals and technical directives that are available and may be requisitioned. The introduction to the stock list provides complete instructions on the procedures for requisitioning NAVAIR technical manuals and technical directives.

To supplement the NAVSUP Publication 2002, the Naval Air Technical Services Facility (NATSF), issues the Naval Aeronautical Publications Index (NAPI). The NAPI consists of four companion indexes used by maintenance personnel to assist them in relating technical manual and technical directives used to specific aircraft models, components, or equipment.

The technical manual-type publication makes available information necessary for the proper operation and maintenance, and gives the safety precautions for the particular equipment about which it is written. Publications of this type serve as a reference for operating, maintaining, and correcting the malfunctions of the equipment. They may also serve as textbooks for operating personnel to study optimum procedures of operation and maintenance established by past experiments and experiences. New and recently revised manuals do not contain detailed descriptions or procedures concerning preventive maintenance since this information is now contained on the 3-M Maintenance Requirements Cards (MCRs). Technical manuals do contain the following:

1. Description of equipment.
2. Theory of operation.
3. Troubleshooting techniques.
4. Corrective maintenance information.
5. Specific safety information.
6. Parts breakdown and numbers.
7. Sketches, diagrams, schematics, operating and design limits, etc.

CONTROLLED-EQUIPAGE CUSTODY RECORD- NAVSUP FORM 306 (REV. 3-70)

| FSN/PART NO. | NOUN NAME | ALLOWANCE | U/I | UNIT PRICE | DEPARTMENT | CARD NO. |
|---|---|---|---|---|---|---|
| G5130-00-289-1054 | DRILL | 6 | Ea | 40.00 | AIR | G-15 |

A/L NO. III
PAGE 49 LINE 15
ADD'L DESCRIPTION: Electric, Portable, light duty
SERIAL NO.

| O/S REQ'N (No.) | (Qty) | O/S REQ'N (No.) | (Qty) | O/S REQ'N (No.) | (Qty) | O/S REQ'N (No.) | (Qty) | CUSTODY SIGNATURE REQUIRED | [X] YES | [ ] NO |
|---|---|---|---|---|---|---|---|---|---|---|

TRANSACTION RECORD

| DATE | DOCUMENT NO. | RECEIVED FROM EXPENDED TO | QUANTITY REC'D | QUANTITY EXPENDED | QUANTITY BALANCE | I acknowledge custody of this item in the quantity specified. |
|---|---|---|---|---|---|---|
| 1-9-75 | 342 | S. O. | 6 | | 6 | B. J. Jacops |
| 2-7-75 | 12 | Survey | | 2 | 4 | G. F. Mascarita |
| 3-5-75 | 410 | S. O. | 2 | | 6 | B. J. Jacops |

(A) FRONT SIDE

STOCK NO. 0108-500-6501

INVENTORY RECORD

| DATE | QUANTITY | INVENTORIED BY | ADDITIONAL INFORMATION (As required) |
|---|---|---|---|
| 1-30-75 | 6 | F. Sarens | 2 Drills found to be in survey condition |
| 2-30-75 | 6 | F. Sarens | N/A |

(B) REVERSE SIDE

195.30.3

Figure 8-1. — Controlled-Equipage Custody Card (NAVSUP Form 306).

| G-5 | AIR | 123-00-456-7890 | TOW BAR | 100 | Ea | III 15 5 | 300.00 |
|---|---|---|---|---|---|---|---|
| (Card No.) | (Department) | (FSN/Part No.) | (Noun name) | (Allowance) | (U/I) | (A/L No. - Page-Line) | (Unit price) |

**CONTROLLED-EQUIPAGE CUSTODY RECORD (4442)**
**NAVSUP FORM 460 (Rev. 3-70)**

CUSTODY SIGNATURE REQUIRED ▶ [X] YES [ ] NO

TRANSACTION RECORD

| DATE | DOCUMENT NO. | REC'D FROM/EXPEND. TO | REC'D | EXPEND. | BALANCE | I acknowledge custody of this item in the quantity indicated. |
|---|---|---|---|---|---|---|
| 1-9-75 | B-13 | S. O. | 70 | | 70 | B. J. Jacops |
| 2-10-75 | B-50 | S. O. | 15 | | 85 | R. T. Navarik |
| 3-28-75 | C-10 | Survey | | 5 | 80 | B. J. Jacops |
| 4-15-75 | C-50 | S. O. | 20 | | 100 | R. T. Navarik B. J. Jacops |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

INVENTORY RECORD

| DATE | QTY | BY |
|---|---|---|
| | | |
| 3-28-75 | 80 | |
| | | |
| | | |
| | | |
| | | |
| | | |

| O/S REQ'N (No.) | (Qty) | O/S REQ'N (No.) | (Qty) | O/S REQ'N (No.) | (Qty) | O/S REQ'N (No.) | (Qty) | O/S REQ'N (No.) | (Qty) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |

SERIAL NO.

ADD'L DESCRIPTION
NT-4 UNIVERSAL TOW BAR

| CARD NO. | DEPARTMENT | FSN/PART NO. | NOUN NAME | ALLOWANCE | U/I | A/L NO: III PAGE: 15 LINE: 5 | UNIT PRICE |
|---|---|---|---|---|---|---|---|
| G-5 | AIR | 123-00-456-7890 | TOW BAR | 100 | Ea | | 300.00 |

12 24 36 48 60 72 84

STOCK NO. 0108-501-0802 A-30960

Figure 8-2. — Controlled-Equipage Custody Record (4442) (NAVSUP Form 460).

## PROCUREMENT OF PUBLICATIONS

Manual-type publications may be obtained by properly preparing and submitting DOD Single Line Item Requisition System Document (DD Form 1348 or 1348m) to the nearest supply point (Keep in mind that this type of procurement is a one-time order only). List the publications code number, National stock number, and title of each manual desired.

Letter-type publications should be ordered using DD Form 1149, in accordance with the instructions given on the cover page of NAVSUP 2002.

Requests to be placed on the mailing list for NAVSUP 2002, and supplements should be submitted to NATSF, 700 Robbins Avenue, Philadelphia, Pennsylvania 19111. NAVSUP 2002 is revised and re-issued semiannually. During the interval between issues, supplements are issued containing listings of publications distributed or canceled since the last issue.

## MAINTENANCE AND FILING OF PUBLICATIONS

There are four mandatory requirements to be met in maintaining an allowance of publications. These requirements are as follows:

1. That the prescribed publications be on board.
2. That the publication be corrected up-to-date.
3. That they be ready for immediate use.
4. That applicable security provisions be observed.

Most changes to publications are issued either in the form of looseleaf pages, pen-and-ink changes, or complete revision. When changes are issued in the form of numbered pages, the old page with the corresponding number is removed and the new replacement page inserted in its place. Specific instructions are normally given with each change on the method to be used in incorporating the change. Changes should be made immediately upon receipt.

A checklist of pages that are to remain in the publication after the change has been incorporated is provided with changes issued for some publications. This checklist should be compared against pages remaining in the publication to insure they agree. Extra pages are removed and missing pages ordered to bring the publication up to date. Obsolete pages removed should be secured together and retained until the next change is received. Sometimes the wrong pages are removed from a publication when a change is entered and the error is not discovered, even with the checklist, until the next change is entered.

When pen-and-ink changes are made, the change number and date should be entered with each change for future reference. Sometimes it is convenient to cut out pen-and-ink changes and insert them in their proper place in a publication by fastening them with a transparent tape or mucilage.

## RECORDS, REPORTS, AND SCHEDULES

The records, reports, and schedules discussed in this section are a selection of some of the more important that senior petty officers will encounter in their billets as leading petty officer, supervisor, and/or leader. When preparing any report/schedule, etc., bear in mind that it should be as accurate and complete as possible, whether it is prepared personally or under your direction. In either case it is a personal reflection on you as a petty officer.

## UNSATISFACTORY MATERIAL/ CONDITION REPORT

The Unsatisfactory Material/Condition Report (UR) was created to obtain service experience information from the most reliable sources. The major aspects of the program are the collecting, compiling, and analyzing of service experience with aeronautical materials to determine areas of immediate failures and trends of impending failures, and to coordinate efforts to correct material deficiencies and improve flight safety, operational utility, and logistic support for operating aircraft.

The rapid collection and dissemination of service experience data to cognizant governmental activities are necessary in order to rapidly initiate appropriate action to ensure more reliable equipment in fleet service. In this regard, the assignment of competent personnel to supervise and review Unsatisfactory Material/ Condition Report preparation is mandatory.

The basic form used for reporting failures, deficiencies, or malfunctions of equipment is the Unsatisfactory Material/Condition Report (UR), OPNAV 4790/47. (See fig. 8-3.)

UR

**UNSATISFACTORY MATERIAL/CONDITION REPORT**

(Use typewriter or ball point pen.) (See Instructions For Preparation of Form in OPNAVINST 4790-2A) Report Symbol OPNAV 4790-6

UR

| 1. REPORTING ACTIVITY | 2. LOCATION | 3. SER. NO. | 4. DATE OF TROUBLE | 5. REPORT CATEGORY | 6. MSG DTG |
|---|---|---|---|---|---|
| USS AMERICA CVA66 | NORVA | 0001 | 1 JULY 1975 | ☒ SPECIAL | |

| 7. INSTALLED ON (Type Aircraft/Ship, Support Equip, etc.) | 8. BUREAU/SERIAL/HULL NO. | 9. TECHNICAL DATA DEFICIENCY-TECHNICAL DATA IDENTIFICATION (Amplify in space 39) |
|---|---|---|
| TOW TRACTOR | T-12345 | ☐ YES ☒ NO |

| 10. JOB CONTROL NUMBER ORG. / DATE / SEQ. NO. / SUF | 11. MAINT. CONTROL NUMBER | 12. WUC/EIC | 13. TYPE EQUIP. | 14. |
|---|---|---|---|---|
| | 0025 | TT12 | | ☐ FOLLOW-UP REPORT |

**DEFICIENT ITEM DATA**

| 15. MANUFACTURER'S PART NO. | 16. NOMENCLATURE | 17. SERIAL NO. | 18. QUANTITY |
|---|---|---|---|
| 31517-6 | TOWBAR | Unknown | 1 |

| 19. FEDERAL STOCK NO. (FSN) | 20. FEDERAL MFR'S CODE | 21. CONTRACT NO. | 22. MILITARY/COMMERCIAL OVERHAUL ACT. |
|---|---|---|---|
| | | | |

| 23. TIME COUNT SINCE NEW | 24. TIME COUNT SINCE OVERHAUL | 25. NUMBER OF EVENTS (Cycles, starts, etc.) |
|---|---|---|
| | | 0 |

26. INSTALLED ON (Indicate major component and end item on which defective item is installed or applicable to)

| | PART NUMBER | NOMENCLATURE | TYPE/MODEL & SERIES | SERIAL NUMBER |
|---|---|---|---|---|
| SYSTEM/EQUIPMENT/ENGINE, ETC. | 31517-6 | TOWBAR | NT-4 | 0023 |
| UNIT/COMPONENT OR EQUIPAGE | | | | |
| SUBASSEMBLY | | | | |

| | | | | |
|---|---|---|---|---|
| 27. REASON FOR REPORT (Place X in proper box) | 1 ☐ FAILURE/SUSPECTED FAILURE OR MALFUNCTION | 2 ☐ DAMAGED DUE TO IMPROPER MAINTENANCE/OPERATION/TEST | 3 ☒ DAMAGED OR DEFECTIVE ON RECEIPT | 4 ☐ CAN BE INSTALLED WRONG |
| 28. DISPOSITION (Place X in proper box) | 1 ☐ HOLDING 30 DAYS FOR INVESTIGATION | 2 ☐ RELEASED FOR INVESTIGATION (Amplify in space 39) | 3 ☐ REPAIRED MADE RFI (Amplify in space 39) | 4 ☒ RETURNED TO SUPPLY/DISPOSED OF (Amplify in space 39) |

29. AMPLIFYING DETAILS (1. Circumstances existing prior to difficulty. 2. Description of difficulty. 3. Cause 4. Action Taken 5. Recommended disposition instructions (if applicable). 6. Recommendations. 7. List specific activity that is holding the material.)

Found to be defective upon receipt from supply

(If additional space is required, tear out and reverse carbons. Use reverse side. Use typewriter or ball point pen.)

| 30 SUBMITTING ACTIVITY | NAME/RATE | DATE |
|---|---|---|
| APPROVED BY J.C. SEVERNS | ABCS | 1 JULY 1975 |
| 31 SUPPORTING AIMD (If Applicable) | NAME/RATE | DATE |
| APPROVED BY | | |

UNSATISFACTORY MATERIAL/CONDITION REPORT OPNAV 4790/47 (1-73) S/N 0107-770-5001

Forward ORIGINAL to Maintenance Engineering CFA (Cognizant Field Activity)
Retain one FILE copy for record purposes
Attach TAG copy (hard copy) to material being turned in to supply or released for investigation

196.4

Figure 8-3.—UR Form.

The UR provides for submittal of specific information considered essential to conduct a complete evaluation and analysis of problem areas associated with catapults or arresting gear. The UR is required in order that complete statistical data and records concerning unsatisfactory material and failures may be compiled and appropriate corrective action taken. The reports include sudden failures (broken parts, etc.) as well as gradual failures (due to corrosion, foreign particles, stress, cracks, etc.). Conscientious reporting and the submission of detailed opinions and observations on failed or unsatisfactory items from the service will greatly help to process this data.

The UR form has provision for the originator to submit a report in various categories. Space 5 of the UR must indicate the category as determined by the reporting activity. Guides for this selection are as follows:

1. SPECIAL—indicates that the particular condition is a result of discrepancies in design, maintenance, technical data, quality control (new manufacture or overhaul), or foreign object damage, but is not itself critical in nature. Other special situations, such as not meeting expected performance life or other parameters which require reporting, fall into this category.

2. SAFETY—indicates a priority over all other reports. The originator selects this category when reporting deficient material conditions which, if not corrected, would result in fatal or serious injury to personnel or extensive damage or destruction to equipment; or for conditions that contribute to or could contribute to an accident or incident. A SAFETY Unsatisfactory Material/Condition Message should be initiated on the date the trouble occurs, but in no case later than 24 hours. The message must be assigned a "priority" rating. The SAFETY UR message must be followed up by a SAFETY UR.

The UR is provided in a carbon-backed three-page set. To obtain legible copies, it is recommended that either uppercase letters on a typewriter or a ball-point pen be used.

The instructions for preparation of the Unsatisfactory Material/Condition Report (UR), printed on the first page of the three-page UR set, must be followed completely. Read all instructions thoroughly before filling in the UR.

The UR set is prepared in all cases when an accountable part is removed and replaced by a part drawn from supply, or when a part is delivered to a supporting maintenance activity for repair or replacement. The purpose of each section is as follows:

1. The first sheet in the set is the ORIGINAL document which is transmitted to the UR Center, NATSF (MR). Pertinent data from the UR is entered on the other parts of the UR set by carbon registration.

2. The FILE copy is retained by the UR report originator for record purposes. A file copy should be retained for 6 months by the reporting activity or the supporting maintenance activity, as appropriate.

3. The TAG copy (hard copy) is a complete carbon copy of the UR that is attached to material being turned in to supply or released for investigation.

Failed material should be retained at the field site with a legible TAG copy (hard copy) of the UR report securely attached to it. ALL ORIGINAL URs or first sheet of UR sets, with photographs and/or drawings, are forwarded to the Naval Air Technical Services Facility (MR), 700 Robbins Avenue, Philadelphia, Pennsylvania 19111. OPNAV Form 4790/47A is a single copy version of the UR Form. Its purpose is to provide for preliminary "Rough draft" preparation and for internal application. Under no circumstances will the single copy UR be submitted as an action document for reporting deficiencies. Detailed information for filling out URs can be found in OPNAVINST 4790.2A, Volume II, CHAPTER 17.

## WORK AND MAINTENANCE LOGS

Daily work and/or maintenance logs may be kept to be used as sources of information in the preparation of MDCS documents. It is suggested that a logbook be kept for each work center and reviewed at regular intervals to ascertain that all pertinent information has been documented. A logbook suitable for this purpose may be requisitioned from General Services Administration (GSA) under national stock number 7530-00-22-3525. This is a ledger-type book with a hard cover binder and ruled pages.

## 3-M SYSTEM

For complete information relating to the 3-M System refer to OPNAVINST 4790.4. This information, when complete, will consist of four volumes and will supersede OPNAV 43P2. This change from one book to four volumes will

provide a user-oriented document directed to four specific areas of use.

Volume I is directed to all users as an overall introduction to the 3-M organization, including responsibilities, training, and reports available from the system. Volume I also deals specifically with the Planned Maintenance Sub-System (PMS).

Volume II is also directed to all users and contains the Maintenance Data Collection Sub-System (MDCS) procedures.

Volume III of the manual covers intermediate maintenance activities procedures, and will be used principally by those organizations.

Volume IV is useful to all activities and deals with MDCS specifications, error corrections, and products available.

## APPENDIX I

# U.S. CUSTOMARY AND METRIC SYSTEM UNITS OF MEASUREMENTS

## THESE PREFIXES MAY BE APPLIED TO ALL SI UNITS

| Multiples and Submultiples | Prefixes | Symbols |
|---|---|---|
| 1 000 000 000 000 = $10^{12}$ | tera (tĕr′ȧ) | T |
| 1 000 000 000 = $10^{9}$ | giga (jĭ′gȧ) | G |
| 1 000 000 = $10^{6}$ | mega (mĕg′ȧ) | M* |
| 1 000 = $10^{3}$ | kilo (kĭl′ō) | k* |
| 100 = $10^{2}$ | hecto (hĕk′tō) | h |
| 10 = $10$ | deka (dĕk′ȧ) | da |
| 0.1 = $10^{-1}$ | deci (dĕs′ĭ) | d |
| 0.01 = $10^{-2}$ | centi (sĕn′tĭ) | c* |
| 0.001 = $10^{-3}$ | milli (mĭl′ĭ) | m* |
| 0.000 001 = $10^{-6}$ | micro (mī′krō) | μ* |
| 0.000 000 001 = $10^{-9}$ | nano (năn′ō) | n |
| 0.000 000 000 001 = $10^{-12}$ | pico (pē′kō) | p |
| 0.000 000 000 000 001 = $10^{-15}$ | femto (fĕm′tō) | f |
| 0.000 000 000 000 000 001 = $10^{-18}$ | atto (ăt′tō) | a |

*Most commonly used

# COMMON EQUIVALENTS AND CONVERSIONS

| Approximate Common Equivalents | | Conversions Accurate to Parts Per Million | |
|---|---|---|---|
| 1 inch | = 25 millimeters | inches x 25.4* | = millimeters |
| 1 foot | = 0.3 meter | feet x 0.3048* | = meters |
| 1 yard | = 0.9 meter | yards x 0.9144* | = meters |
| 1 mile | = 1.6 kilometers | miles x 1.609 34 | = kilometers |
| 1 square inch | = 6.5 square centimeters | square inches x 6.4516* | = square centimeters |
| 1 square foot | = 0.09 square meter | square feet x 0.092 903 0 | = square meters |
| 1 square yard | = 0.8 square meter | square yards x 0.836 127 | = square meters |
| 1 acre | = 0.4 hectare † | acres x 0.404 686 | = hectares |
| 1 cubic inch | = 16 cubic centimeters | cubic inches x 16.3871 | = cubic centimeters |
| 1 cubic foot | = 0.03 cubic meter | cubic feet x 0.028 316 8 | = cubic meters |
| 1 cubic yard | = 0.8 cubic meter | cubic yards x 0.764 555 | = cubic meters |
| 1 quart (lq.) | = 1 liter † | quarts (lq.) x 0.946 353 | = liters |
| 1 gallon | = 0.004 cubic meter | gallons x 0.003 785 41 | = cubic meters |
| 1 ounce (avdp) | = 28 grams | ounces (avdp) x 28.349 5 | = grams |
| 1 pound (avdp) | = 0.45 kilogram | pounds (avdp) x 0.453 592 | = kilograms |
| 1 horsepower | = 0.75 kilowatt | horsepower x 0.745 700 | = kilowatts |
| 1 millimeter | = 0.04 inch | millimeters x 0.039 370 1 | = inches |
| 1 meter | = 3.3 feet | meters x 3.280 84 | = feet |
| 1 meter | = 1.1 yards | meters x 1.093 61 | = yards |
| 1 kilometer | = 0.6 mile | kilometers x 0.621 371 | = miles |
| 1 square centimeter | = 0.16 square inch | square centimeters x 0.155 000 | = square inches |
| 1 square meter | = 11 square feet | square meters x 10.7639 | = square feet |
| 1 square meter | = 1.2 square yards | square meters x 1.195 99 | = square yards |
| 1 hectare † | = 2.5 acres | hectares x 2.471 05 | = acres |
| 1 cubic centimeter | = 0.06 cubic inch | cubic centimeters x 0.061 023 7 | = cubic inches |
| 1 cubic meter | = 35 cubic feet | cubic meters x 35.3147 | = cubic feet |
| 1 cubic meter | = 1.3 cubic yards | cubic meters x 1.307 95 | = cubic yards |
| 1 liter † | = 1 quart (lq.) | liters x 1.056 69 | = quarts (lq.) |
| 1 cubic meter | = 250 gallons | cubic meters x 264.172 | = gallons |
| 1 gram | = 0.035 ounces (avdp) | grams x 035 274 0 | = ounces (avdp) |
| 1 kilogram | = 2.2 pounds (avdp) | kilograms x 2.204 62 | = pounds (avdp) |
| 1 kilowatt | = 1.3 horsepower | kilowatts x 1.341 02 | = horsepower |

† common term not used in SI

*exact

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# QUALIFICATIONS FOR ADVANCEMENT

This appendix provides you with a list of the minimum qualifications for advancement to Aviation Boatswain's Mate H (Aircraft Handling) First Class and Chief Petty Officer. The official source of this list is the Manual of Qualifications for Advancement, NAVPERS 18068-C, 1971. The assignment numbers given opposite the qualifications refer to the assignments in the NRCC, Aviation Boatswain's Mate I & C, NAVEDTRA 10303-C. Each course assignment contains information related to a practical or knowledge factor, as shown.

AVIATION BOATSWAIN'S MATE H (Aircraft Handling) - ABH

Aviation Boatswain's Mates (H) direct the movement and spotting of aircraft ashore and afloat; operate, maintain and perform organizational maintenance on ground-handling equipment used for moving and hoisting of aircraft ashore and afloat; supervise securing of aircraft and equipment; perform crash rescue, fire-fighting, crash removal, and damage control duties; and perform duties in connection with launching and recovery of aircraft ashore and afloat.

| QUALIFICATIONS FOR ADVANCEMENT | Required for Advancement to ABH | Covered in Assignment |
|---|---|---|
| A. SAFETY | | |
| 1.00 Practical Factors | | |
| .81 Interpret directives and instructions on safety precautions applicable to: | | |
| Aircraft handling and related equipment; establish safeguards, procedures, and standards to ensure compliance by personnel supervised . . . . . | E-7 | 1 & 2 |
| E. AIRCRAFT HANDLING, TOWING, AND HOISTING | | |
| 1.00 Practical Factors | | |
| .61 Reeve cables on aircraft cranes and crash cranes . . . . . | E-6 | 2 |
| .80 Plan spotting of aircraft on flight and hangar decks in accordance with operational plans . . . . . | E-7 | 2 & 3 |

| QUALIFICATIONS FOR ADVANCEMENT | Required for Advancement to ABH | Covered in Assignment |
|---|---|---|
| E. AIRCRAFT HANDLING, TOWING, AND HOISTING - Continued | | |
| 1.00 Practical Factors | | |
| .81 Conduct prelaunch briefings of plane directors | E-7 | 2 & 3 |
| .83 Direct the movement and spotting of aircraft during launching, landing, and respotting operations aboard aircraft carriers | E-7 | 2 & 3 |
| 2.00 Knowledge Factors | | |
| .80 Capabilities and limitations of aircraft handling, towing, and hoisting equipment | E-7 | 3 |
| F. CRASH RESCUE AND DAMAGE CONTROL | | |
| 1.00 Practical Factors | | |
| .59 Direct: | | |
| d. Flight deck damage control repair party | E-6 | 3, 4, 5, 6 |
| e. Unit of a deck, water, or land crash fire and rescue group | E-6 | 3, 4, 5, 6 |
| f. A deck, water, or land crash fire and rescue group | E-7 | 3, 4, 5, 6 |
| .80 Organize: | | |
| b. Flight deck damage control repair party | E-7 | 3, 4, 5, 6 |
| .81 Operate and test water washdown system | E-7 | 3, 4, 5, 6 |
| G. GENERAL MAINTENANCE PRACTICES AND PROCEDURES | | |
| 1.00 Practical Factors | | |
| .60 Interpret blueprints and drawings and make working sketches | E-6 | 7 |
| .80 Screen defective components for feasibility of repair | E-7 | 7 |
| Z. ADMINISTRATION | | |
| 1.00 Practical Factors | | |
| b. Prepare a weekly schedule of preventive maintenance | E-6 | 7 |

| QUALIFICATIONS FOR ADVANCEMENT | Required for Advancement to ABH | Covered in Assignment |
|---|---|---|
| Z. ADMINISTRATION - Continued | | |
| 1.00 Practical Factors | | |
| c. Prepare a Planned Maintenance System Feedback Report | E-6 | 7 |
| d. Assist in the preparation of a quarterly schedule of preventive maintenance | E-7 | 7 |
| .60 Enter test data and work accomplished in logs and equipment histories | E-6 | 7 |
| .61 Prepare and evaluate: | | |
| a. Equipment failure reports | E-6 | 7 |
| b. MAF's, SAF's, UR's, TDC's and MHA cards | E-6 | 7 |
| .62 Identify tools, equipment, parts, and material by nomenclature and stock number and prepare supply requisitions to obtain replacements | E-6 | 7 |
| .63 Conduct inventories and maintain custody records | E-6 | 7 |
| *.70 Post changes and additions to COSAL including: | | |
| a. Adding or deleting Allowance Parts List (APL) or Allowance Equipment List (AEL) items | E-6 | 7 |
| b. Correcting COSAL Index | E-6 | 7 |
| .80 Supervise the use, filing and maintenance of publications, logs, and records | E-7 | 7 |
| .81 Prepare for extended operations by ensuring spare parts, equipment, and personnel requirements | E-7 | 7 |
| .82 Supervise inspection procedures to ensure that applicable technical specifications and standards of workmanship are met | E-7 | 7 |
| * Coverage of shore-based arresting gear as provided in Assignment | | 4 & 5 |

NOTE: G1.60 Blueprints are covered in NAVPERS 10077.

# AVIATION BOATSWAIN'S MATE H 1 & C

**NAVEDTRA 10303-C**

This course was prepared by the Naval Education
and Training Program Development Center, Pensacola, Florida

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This course consists of this assignment booklet, the accompanying rate training manual, and the answer sheets. Each assignment is made up of a series of items based on assignment readings in the textbook. At the beginning of each assignment is listed the specific text material that should be studied. The answer sheets to be completed are enclosed as a separate package.

If there is an errata sheet included with this course, make all indicated changes and corrections in the assignment booklet and textbook.

## ● HOW TO COMPLETE THIS COURSE SUCCESSFULLY

To complete this course successfully, you must meet the following standards: If you are on active duty, the average of the grades earned on all assignments must be at least 3.2. If you are not on active duty, the average of the grades earned on all assignments in each creditable unit of the course must be at least 3.2. (See the Naval Reserve Retirement box for the retirement points evaluated for this course.)

Study those pages of the textbook listed for each assignment. Pay particular attention to the illustrations as they give a lot of information in a small space. Making your own drawings will help you understand some of the explanations you read. Also, read the learning objectives. They will tell you what you will be able to do after having read the material and answered the study items.

Read each item carefully. Consult your textbook to help you select the best answer. You may discuss difficult points in the course with your Division Officer or shipmates. However, the answer that you select must be your own. Indicate your answer directly on the answer sheet by erasing the appropriate block. If a page number appears, you have made an incorrect answer. Restudy the text, starting at that page, and make another selection. A correct answer for each item is made when a "C", "CC", or "CCC" is exposed. Scoring the answer sheets is explained at the top of the answer sheet.

You may find that some of the text content has become obsolete since the text was written. However, since the course is based on the textbook, in answering items be sure to select the best answer from the information in the textbook. The obsolete matter in the textbook will be brought up-to-date when the text is revised.

Use only the designated answer sheet for each assignment. Follow the directions found on the answer sheet to determine the proper procedures for completing it.

The enrollee should exercise care in erasing, as an inadvertent erasure will be considered an error. However, the scoring table is adjusted to absorb occasional error in erasures without course failure. Note: The NAVEDTRAPRODEVCEN is not staffed to process letters pertaining to erasure errors.

## ● WHO WILL ADMINISTER YOUR COURSE

If you are assigned to a command which maintains your records, your nonresident career course will be administered by your Command. All other courses will be administered by the Naval Education and Training Program Development Center. Consult your Division Officer and follow the instructions stated below for local Administration if your course is administered by your Command. Follow the instructions for Naval Education and Training Program Development Center administration if your course will be administered by the Center.

## ● WHEN THE COURSE IS ADMINISTERED BY YOUR COMMAND

Adhere as closely as possible to a schedule of at least one assignment per month. If this is not possible, consult with your Division Officer, explaining your difficulty. A time extension will be granted if justified.

Before completing the answer sheet, fill in all blanks at the top of the answer sheet. You may wish to record your score in the assignment booklet as a check on your progress since IKOR answer sheets are not returned.

Submit your completed assignments to the officer administering your course. He will discuss with you any of the questions that you do not understand. When the entire course has been completed and a satisfactory grade attained, a notation to this effect should be made by your local Command in your service record. By this means you will be given credit for your work.

The Naval Education and Training Program Development Center DOES NOT ISSUE Letters of Satisfactory Completion to enrollees who have their courses administered by their own Commands.

WHEN THE COURSE IS ADMINISTERED BY THE NAVAL EDUCATION AND TRAINING PROGRAM DEVELOPMENT CENTER

Plan your schedule of completing assignments so that you will meet the course requirement in time to qualify for the regularly scheduled fleet-wide competitive examination for advancement.

The enrollee should plan on completing at least ONE ASSIGNMENT PER MONTH to meet the minimum requirements established by the Chief of Naval Personnel, and to ensure completion of the Course before disenrollment procedures are initiated by the Center.

Enrollees are to retain each completed assignment until a creditable unit is finished (or the entire course if the course is not devided into units), at which time the assignments are to be forwarded to the Center in one of the envelopes provided. The enrollee should record his grades, as the IKOR answer sheets are not returned by the Center. If you are a Reservist, delay in submitting each creditable unit may prevent you from earning enough retirement points to complete a year of Satisfactory Federal Service.

The Center will verify and record your assignment scores and will notify you of your final grade by issuing a Letter of Satisfactory Completion. Completion of creditable units of a course will also be certified by stamping the assignment of each unit with the unit average grade and date.

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WHEN PREPARING FOR YOUR ADVANCEMENT EXAMINATION

Your examination for advancement will be based on the Manual of Qualifications for Advancement, NAVPERS 18068-D, or based on the latest edition of the Manual of Navy Enlisted Manpower and Personnel Classifications and Occupational Standards (scheduled to be used in preparing examinations administered after 1 January 1977). It is possible that the occupational standards for your rating may have changed since this nonresident career course and its accompanying textbook were printed.

Information in this Nonresident Career Course, in the Rate Training Manual, and in the current edition of Bibliography for Advancement Study (NAVEDTRA 10052) is intended to help you determine study materials on which the examinations will be based.

To further assist you in preparing for your advancement exam, Naval Education and Training Program Development Center publishes annually Qualification and Bibliography Sheets (to be replaced by Occupational Standards and Bibliography Sheets in calendar year 1977) which are distributed by your Educational Services Officer. These sheets are reprints of the latest qualifications and bibliography of your rating.

NAVAL RESERVE RETIREMENT

This course is evaluated at 12 Naval Reserve retirement points. These points are creditable to personnel eligible to receive them under current directives governing retirement of Naval Reserve personnel. Points will be credited upon satisfactory completion of the entire course.

Naval Reserve retirement credit will not be given for this course if the student has previously received credit for any ABH 1&C ECC, ECC/FITS, or NRCC.

Naval nonresident career courses may include a variety of items -- multiple-choice, true-false, matching, etc. The items are not grouped by type; regardless of type, they are presented in the same general sequence as the textbook material upon which they are based. This presentation is designed to preserve continuity of thought, permitting step-by-step development of ideas. Some courses use many types of items, thers only a few. The student can readily identify the type of each item (and the action required o. him) through inspection of the samples given below.

## MULTIPLE-CHOICE ITEMS

Each item contains several alternatives, one of which provides the best answer to the item. Select the best alternative and erase the appropriate box on the answer sheet.

### SAMPLE

s-1. The first person to be appointed Secretary of Defense under the National Security Act of 1947 was
1. George Marshall
2. James Forrestal
3. Chester Nimitz
4. William Halsey

The erasure of a correct answer is indicated in this way on the answer sheet:

## TRUE-FALSE ITEMS

Determine if the statement is true or false. If any part of the statement is false the statement is to be considered false. Erase the appropriate box on the answer sheet as indicated below.

### SAMPLE

s-2. Any naval officer is authorized to correspond officially with a bureau of the Navy Department without his commanding officer's endorsement.

The erasure of a correct answer is also indicated in this way on the answer sheet:

## MATCHING ITEMS

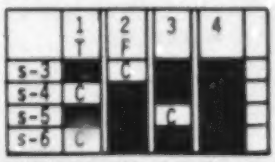
Each set of items consists of two columns, each listing words, phrases or sentences. The task is to select the item in column B which is the best match for the item in column A that is being considered. Specific instructions are given with each set of items. Select the numbers identifying the answers and erase the appropriate boxes on the answer sheet.

### SAMPLE

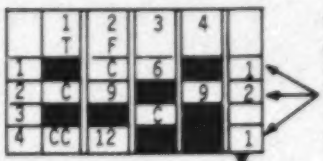
In items s-3 through s-6, match the name of the shipboard officer in column A by selecting from column B the name of the department in which the officer functions.

| A. Officers | B. Departments |
|---|---|
| s-3. Damage Control Assistant | 1. Operations Department |
| s-4. CIC Officer | 2. Engineering Department |
| s-5. Assistant for Disbursing | 3. Supply Department |
| s-6. Communications Officer | |

The erasure of a correct answer is indicated in this way on the answer sheet:




## How To Score Your Immediate Knowledge of Results (IKOR) Answer Sheets




Total the number of incorrect erasures (those that show page numbers) for each item and place in the blank space at the end of each item.

Sample only

| Number of boxes erased incorrectly | 0-2 | 3-7 | 8- |
|---|---|---|---|
| Your score | 4.0 | 3.9 | 3.8 |

Now TOTAL the column(s) of incorrect erasures and find your score in the Table at the bottom of EACH answer sheet.

NOTICE: If, on erasing, a page number appears, review text (starting on that page) and erase again until "C", "CC", or "CCC" appears. For courses administered by the Center, the maximum number of points (or incorrect erasures) will be deducted from each item which does NOT have a "C", "CC", or "CCC" uncovered (i.e., 3 pts. for four choice items, 2 pts. for three choice items, and 1 pt. for T/F items).

While working on a course a student may refer freely to open-book texts and references. He may seek advice and instruction from others on problems arising in the course, but the solutions submitted must be the result of the student's own work and decisions. The student is prohibited from referring to or copying the solutions of others, or giving completed solutions to anyone else taking the same course. Noncompliance can result in suspension from the course by the administering activity and disciplinary action by the Chief of Naval Personnel.

## WHAT IS THE COURSE OBJECTIVE

While completing this Nonresident Career Course, the student will demonstrate his understanding of course materials by correctly answering items on the following: the ABH rating requirements, qualifications, available sources of information, types of training material, procedures involved in advancement, and suggested study habits; the capabilities and limitations, related safety precautions, and operating procedures for aircraft handling equipment; aircraft handling procedures; duties, responsibilities, and organizational structure of crash crews; emergency fire rescue equipment and rescue procedures ashore; emergency arresting gear and related equipment; shipboard firefighting procedures and equipment; damage control organization, responsibilities, and operating procedures; work center management; requisitioning, inventory, and survey procedures; and use, filing, and maintenance of technical publications.

# Assignment 1

Aviation Boatswain's Mate Rating and Aircraft Handling Equipment

Text: Pages 1 - 20

In this course you will demonstrate that learning has taken place by correctly answering training items. The mere physical act of indicating a choice on an answer sheet is not in itself important; it is the mental achievement, in whatever form it may take, prior to the physical act that is important and toward which nonresident career course learning objectives are directed. The selection of the correct choice for a course training item indicates that you have fulfilled, at least in part, the stated objective(s).

The accomplishment of certain objectives, for example, a physical act such as drafting a memo, cannot readily be determined by means of objective type course items; however, you can demonstrate by means of answers to training items that you have acquired the requisite knowledge to perform the physical act. The accomplishment of certain other learning objectives, for example, the mental acts of comparing, recognizing, evaluating, choosing, selecting, etc., may be readily demonstrated in a course by indicating the correct answers to training items.

The comprehensive objective for this course has already been given. It states the purpose of the course in terms of what you will be able to do as you complete the course.

The detailed objectives in each assignment state what you should accomplish as you progress through the course. They may appear singly or in clusters of closely related objectives, as appropriate; they are followed by items which will enable you to indicate your accomplishment.

All objectives in this course are learning objectives and items are teaching items. They point out important things, they assist in learning, and they should enable you to do a better job for the Navy.

This self-study course is only one part of the total Navy training program; by its very nature it can take you only part of the way to a training goal. Practical experience, schools, selected reading, and the desire to accomplish are also necessary to round out a fully meaningful training program.

---

Learning Objective: Indicate familiarity with the enlisted rating structure, possible duty assignments and responsibilities, and facts pertaining to leadership development.

---

1-1. What ratings have been established in order that personnel may be properly utilized within the scope of a general rating where specialization is required?
1. Service ratings
2. Special ratings
3. Emergency ratings
4. All of the above

1-2. The general rating of Aviation Boatswain's Mate applies to which of the following pay grades?
1. E-2 through E-9
2. E-4 through E-9
3. E-6 through E-8
4. E-8 and E-9

1-3. At which of the following locations would an ABH1 or ABHC most likely fill an instructor's billet?
1. The Naval Education and Training Program Development Center, Pensacola, Fla.
2. The Recruit Training Command
3. The Naval Air Technical Training Center, Lakehurst, N.J.
4. All of the above

1-4. A listing of special programs and projects pertinent to the ABH rating may be found in certain BUPERS Notices and the
1. Enlisted Transfer Manual
2. BUPERS Manual
3. Bibliography for Advancement Study, NAVEDTRA 10052 (Series)
4. Manual of Qualifications for Advancement, NAVPERS 18068 (Series)

1-5. In addition to being an accomplished military leader and a competent technician, what duties should an ABH1 be able to perform?
1. Instructor duties
2. Inspector duties
3. Supervisory duties
4. All of the above

1-6. The leadership required of a senior ABH can be acquired only by
1. understanding leadership principles
2. studying leadership material
3. following the Naval Leadership program
4. hard work and application of leadership principles

1-7. Critical self-evaluation can help a senior petty officer improve the leadership traits in which he is weak.

---

Learning Objective: Recognize advantages of, procedures for, and materials to be studied in preparing for advancement.

---

1-8. Which of the following personal advantages, other than monetary, can be gained from advancement?
1. Greater pride
2. Higher moral
3. Feeling of accomplishment
4. All of the above

1-9. The senior ABH's worth to the Navy is judged in part on the basis of the quality of leadership he displays.

1-10. What must an ABH do to qualify for advancement?
1. Demonstrate his knowledge of the material in the pertinent Rate Training Manual
2. Demonstrate his ability to perform the pertinent practical requirements
3. Have a certain amount of time in grade and be recommended by his commanding officer
4. All of the above

1-11. What should you tell personnel assigned to you concerning advancement?
1. Eligibility for advancement amounts to actual promotion once all training requirements are met
2. A good training record and high written examination scores are sufficient to ensure advancement
3. Advancement is automatic if satisfactory training progress is made
4. Promotion quotas, written examination scores, length of service, and performance marks all affect advancement possibilities

1-12. After an ABH1 has performed the work of his rate satisfactorily for the required length of time and has made a passing score on his written examination, he is automatically advanced to ABHC.

1-13. The publication which indicates the minimum requirements for advancement is
1. Military Requirements for Petty Officers 1 & C, NAVEDTRA 10057 (Series)
2. Bibliography for Advancement Study, NAVEDTRA 10052 (Series)
3. Manual of Qualifications for Advancement, NAVPERS 18068 (Series)
4. Navy Regulations

1-14. Which of the following statements with respect to the "Quals" Manual is correct?
1. It is issued annually by the Bureau of Naval Personnel
2. It covers only the professional requirements for personnel advancement
3. It lists qualifications for general ratings but not for service ratings
4. It covers both military and professional requirements for advancement in all rates and ratings

1-15. The professional requirements for the ABH1 and ABHC rates are given in the "Quals" Manual as
1. knowledge factors and examination subjects
2. practical factors and military factors
3. practical factors and knowledge factors
4. examination subjects and military factors

1-16. Why should a man preparing for advancement to ABHC carefully examine the "Quals" Manual rather than the "quals" listed elsewhere?
1. Because the material from other sources might list only the examination subjects, while the "Quals" Manual lists both the examination subjects and practical factors
2. Because the material from other sources will show what a man is expected to know if he wants to pass the rating exam, but the "Quals" Manual also shows what he should already know
3. Because any revisions to the qualifications for advancement in the ABH rating will be found in the "Quals" Manual and might not be included in other sources
4. For all of the above reasons

1-17. For advancement, enlisted personnel in any pay grade need to demonstrate proficiency in the qualifications specified for the next higher pay grade, and may be required to demonstrate qualifications for all lower pay grades.

1-18. The basis for questions in the written advancement examinations is formed by the
1. knowledge factors of the military and professional qualifications
2. practical factors of the military and professional qualifications
3. knowledge and practical factors of the professional qualifications
4. knowledge factors and practical factors of the military and professional qualifications

1-19. Which of the following entries may be made on the Record of Practical Factors, NAVEDTRA 1414/1?
1. Skills listed as minimum requirements for the ABH rating
2. Skills closely related to the ABH rating but which are not listed as minimum skill requirements
3. Additional changes to the ABH rating qualifications
4. All of the above

1-20. Which of the following actions should an ABH take when he is transferred from one activity to another?
1. Request a statement concerning his qualifications from the activity he is leaving
2. Secure his NAVEDTRA 1414/1 and take it to his new commanding officer
3. Inform his new division chief that he has completed his practical factors
4. Ensure his NAVEDTRA 1414/1 is up to date and is in his service record

1-21 Satisfactory performance of the practical factors is recorded on NAVEDTRA 1414/1, and a copy of this form is issued to each man in which pay grades?
1. E-1 through E-9
2. E-2 through E-8
3. E-4 through E-8
4. E-4 through E-9

1-22. How often and by whom is NAVEDTRA 10052 issued in revised form?
1. Annually by the Chief of Naval Operations
2. Annually by the Naval Education and Training Support Command
3. Semiannually by the Bureau of Naval Personnel
4. Semiannually by the Chief of Naval Operations

1-23. Which of the following is most inclusive with respect to material which should be studied by an ABH preparing for the Navy-wide advancement examinations?
1. The mandatory and recommended courses listed in Bibliography for Advancement Study, NAVEDTRA 10052 (Series)
2. The subjects covered in the "Quals" Manual listed under knowledge factors
3. The mandatory courses only, that are listed in Bibliography for Advancement Study, NAVEDTRA 10052 (Series)
4. Publications pertinent to the professional mechanical aspects of the rating and those relating to military requirements

1-24. How may the requirement for completing a mandatory Rate Training Manual marked with an asterisk (*) in NAVEDTRA 10052 be satisfied?
1. By passing a locally prepared test
2. By passing the Nonresident Career Course based on the designated training manual
3. By successful completion of an appropriate school
4. By any of the above means

1-25. The recommended study references in NAVEDTRA 10052 are supplementary and the student need NOT spend much time on them as they are NOT used as source material for written examinations.

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Learning Objective: Relative to Rate Training Manuals, identify types, uses, numbering systems, and recommended ways to study them.

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1-26. Which of the following training manuals is a Rate Training Manual?
1. Tools and Their Uses, NAVEDTRA 10085-B
2. Blueprint Reading and Sketching, NAVEDTRA 10077-C
3. Standard First Aid Training Course, NAVEDTRA 10081-B
4. Aviation Boatswain's Mate H 1 & C, NAVEDTRA 10303-C

1-27. Aviation Boatswain's Mate H 1 & C, NAVEDTRA 10303-C, is a revision of the original Rate Training Manual.

1-28. The fundamental purpose of a Rate Training Manual is to
1. aid personnel to advance
2. offer advanced study to graduates of Navy schools
3. teach specific equipments to personnel in specific ratings
4. cover the professional and military aspects of specific rates

1-29. What is the first step you should take in starting your study of a Rate Training Manual?
1. Read the chapter headings
2. Outline the entire manual
3. Familiarize yourself with the entire manual
4. Prepare a list of questions to be answered as study progresses

1-30. The reason for including suggestions 4 and 7 in the list of study suggestions given in your textbook is that by following them you
1. are able to peg each subject to an individual qualification as given in the "Quals" Manual
2. familiarize yourself with the aims and contents of the manual and relate the subject areas to your past experiences, thereby creating an excellent learning situation
3. write an outline of the manual which will be a valuable reference for future study
4. are able to separate the military qualifications from the professional qualifications in the manual

1-31. Why is the use of Nonresident Career Courses encouraged?
1. An idea of how much you have learned from the Rate Training Manual can be obtained by taking the course
2. Because these courses assist you in mastering training manual information
3. Because mandatory training manuals can be completed by passing the associated Nonresident Career Course
4. Because of all of the above

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Learning Objective: Recognize increased responsibilities as you advance and the related responsibilities concerning the training of subordinates.

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1-32. An important ability that must be developed as you advance is to
1. impress others with your job knowledge
2. read technical material
3. speak and write in a manner understandable to others
4. write detailed, complete instructions concerning work procedures

1-33. If you have been promoted to ABHC, which title is most inclusive of the traits that you should possess?
1. Counselor
2. Supervisor
3. Administrative technician
4. Disciplinarian

1-34. As a senior petty officer, your authority and that of all officers rests upon the
1. position occupied
2. leadership qualities exhibited
3. degree of specialized knowledge and skills
4. authority conferred by the commanding officer

1-35. Which of the following statements is most applicable to the training of subordinates in technical and military subjects by senior petty officers?
1. Training is conducted any time and any place an opportunity for training exists
2. Training is conducted any time maintenance is to be performed
3. Training is conducted by holding formal or informal sessions during idle periods when no work can be accomplished
4. Training is conducted under any of the above circumstances

1-36. Why should a senior ABH correct the terminology of a junior ABH who constantly refers to a crane as a hoist?
1. Because such technical ignorance should be corrected before the individual may be advanced in rating
2. Because the principles of good training require that a senior petty officer insist upon the use of correct technical terms by his subordinates
3. Because failure to use correct terminology shows an unfamiliarity with the subject and places the individual at a disadvantage in communications which involve the subject
4. Because of all of the above

1-37. A well-planned training program using NAVEDTRA 1414/1 as a curriculum guide should be conducted so that each student will be qualified for the next higher rate by the time he is eligible for advancement.

1-38. In planning long-range on-the-job training programs, senior ABHs should attempt to
1. emphasize study of theory instead of practice
2. emphasize specialization
3. broaden the specialized knowledge and skill of his men
4. make adequate allowance for trial-and-error learning

1-39. As an ABH advances in rating, it is important that he become more and more familiar with the work of other ratings and the mission of the command so that he can direct the work of his group for maximum benefit of the organization as a whole.

1-40. If you should hear about anything new concerning the operation and maintenance of aircraft handling equipment, you should find out everything you can about it because, as a senior petty officer, it is imperative that you keep yourself informed of new changes and developments that affect you or your work in any way.

1-41. How may a senior ABH be sure that he is getting the latest professional information needed for training his men for advancement?
1. By utilizing films listed in the current U.S. Navy Film Catalog, NAVAIR 10-1-777
2. By utilizing only the latest revision of publications that are periodically revised
3. By ensuring that all official changes have been inserted in the publications requiring changes
4. By all of the above means

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Learning Objective: Indicate paths of and requirements for advancement to Senior Chief, Master Chief, Warrant Officer, and Commissioned Officer.

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1-42. Special paths of advancement to Senior and Master Chief, Warrant Officer and Commissioned Officer are open to personnel who demonstrate which of the following qualities?
1. The highest order of leadership and military responsibility
2. Outstanding professional ability
3. Unquestionable moral integrity
4. All of the above

1-43. Which of the following statements is/are correct concerning the requirements for promotion to ABCS and ABCM?
1. Successful completion of the Navy-wide examination is required
2. A recommendation by the commanding officer is required
3. Qualities of leadership must be demonstrated
4. All of the above

1-44. What is the lowest rate level in which enlisted personnel may apply for advancement to Warrant Officer (W-1)?
1. E-5
2. E-6
3. E-7
4. E-8

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Learning Objective: Relative to aircraft handling equipment, recognize the key to its maximum performance, operating characteristics and uses of various types, training requirements, applicable safety precautions, and the senior ABH's role in its operation and maintenance.

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1-45. The ability of the ABH to use safely and properly maintain cranes, spotting dollies, tow tractors, tow bars, chocks, and tiedowns is the key to maximum performance of the equipment.

● Items 1-46 through 1-70 pertain to tow tractors.

1-46. The maneuverability and ease of handling a tow tractor are directly dependent upon which of the following?
1. Its dimensions
2. Its turning radius
3. Its type of transmission
4. All of the above

1-47. The amount of force that a tractor can exert depends upon
1. its dimensions and turning radius
2. its support equipment and dimensions
3. its turning radius and support equipment
4. the type and condition of the surface on which it is being used

1-48. The TA-18 gasoline-powered tractor was designed for
1. towing aircraft on beaching ramps
2. towing and spotting large aircraft at low speeds
3. towing and spotting aircraft on carrier flight decks
4. positioning arresting gear chain on air station runways

1-49. Which of the following tractors has the greatest drawbar pull capacity?
1. MC-2
2. MD-3
3. TA-18
4. TA-75

1-50. The most maneuverable of the following tractors is the
1. MC-2
2. MD-3A
3. TA-18
4. TA-75

1-51. Inasmuch as efficiency of a device is defined as its output divided by its input, which of the following tractors is most efficient on a dry concrete surface if you consider the drawbar pull as its output and weight as its input?
1. MC-2
2. MD-3A
3. TA-18
4. TA-75

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In items 1-52 through 1-55, select from column B the tow tractor that has each characteristic listed in column A.

| | A. Characteristics | B. Tow Tractors |
|---|---|---|
| 1-52. | It has a drawbar pull of 8,500 pounds on dry, level concrete | 1. TA-18 |
| | | 2. MD-3 |
| 1-53. | It has four-wheel drive | 3. TA-75 |
| 1-54. | It has a pushbutton-controlled automatic transmission | |
| 1-55. | It may be equipped with a rear-mounted gas turbine compressor | |

1-56. Which tractor was designed principally for positioning arresting gear chain on air station runways?
1. MC-2
2. MD-1A
3. M-R-S 190
4. TA-75

1-57. In a situation where it is necessary to maneuver a tractor into an opening 8 feet wide and 3 3/4 feet high in order to tie onto a load, which of the following tractors could be used?
1. MC-2
2. MD-3
3. TA-18
4. TA-75

1-58. Even though the ABH1 and ABHC are NOT normally required to drive or operate tractors, it is imperative that they have some knowledge of the operating procedures to be able to train lower rated men.

1-59. On-the-job training can be utilized effectively to indoctrinate and to teach lower rated ABHs how to drive tractors.

1-60. Which of the following statements is a correct comparison relative to the turning space requirement of a four-wheel drive tractor compared with that for a two-wheel drive tractor?
1. The former requires 50 percent more space than the latter
2. The former requires 50 percent less space than the latter
3. The former must have double the space requirement of the latter
4. The latter must have triple the space requirement of the former

1-61. Although someone other than the tractor driver should hook the tow bar to the tractor, if it becomes necessary for the driver to do so, he must make certain that a qualified man is in the cockpit of the aircraft to be towed.

1-62. Even though the ABH is NOT required to repair or maintain tractors, he must have some knowledge of the mechanical difficulties that may be encountered during their operation.

1-63. Most accidents do NOT just happen -- investigation shows that they are the results of carelessness, improper maintenance, or failure to exercise safety precautions.

1-64. Which of the following statements most accurately describes the ABH who is to be assigned the responsibility of driving a tractor?
1. He knows and understands the standard signals used to direct aircraft towing
2. He has been instructed to a satisfactory understanding of the operation of the towing equipment
3. He has mastered the operations section of the technical manual for the tractor he is to operate
4. He is qualified in all of the above areas

1-65. What is the maximum speed permitted when towing an aircraft?
1. 5 mph
2. 11 mph
3. 14 mph
4. 22 mph

1-66. When supervising the use of tractors, the ABH must ensure that
1. applicable safety precautions only are observed
2. prescribed operating and maintenance procedures only are followed
3. a full crew of plane pushers is available
4. the safety precautions, operating, and maintenance procedures are observed

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Learning Objective: Recognize uses, construction features, and operating characteristics of the SD-1C spotting dolly.

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1-67. When the SD-1C spotting dolly is used in congested areas, two operators are required.

1-68. The wheel arrangement of the dolly consists of
1. a driving wheel and two freewheeling caster-type wheels
2. two driven wheels and two freewheeling caster-type wheels
3. two driven wheels and a freewheeling caster-type wheel
4. four separate motor-driven wheels

1-69. What must you do to the handle on the end of the control arm in order to control the forward or backward movement of the dolly?
1. Twist it
2. Depress or raise it
3. Push it to the right or to the left
4. Push it forward or pull it backward

1-70. The use of the dolly is limited to towing, turning, and spotting carrier-type aircraft.

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Learning Objective: Recognize the capabilities, uses, operating procedures, and safety precautions relating to forklift trucks.

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1-71. Standard forklift trucks are available with lifting capacities of 5,000 to 30,000 pounds.

1-72. Forklift trucks are used on palletized loads only.

1-73. With an individual load, the forklift truck should NOT travel more than a maximum distance of
1. 100 ft
2. 200 ft
3. 300 ft
4. 400 ft

1-74. How are forklift trucks rated?
1. By the load which should never be exceeded
2. By the weight of the forklift truck
3. By the size of the forklift truck
4. By the size of the lifting tines

1-75. Why should you always back down a hill or ramp?
1. To aid you in seeing the edge of the ramp
2. Because the brakes are in the front wheels
3. To prevent the load from sliding off
4. So you can safely stop in an emergency

# Assignment 2

Aircraft Handling Equipment and Handling Procedures

Text: Pages 21 - 46

Learning Objective: Identify the required performance characteristics of aircraft cranes, their types, construction features, operating characteristics, uses, related handling signals, and safety precautions.

2-1. Which of the following is required when a crane is used to lift aircraft?
1. Smooth acceleration and deceleration
2. A wide range of speed
3. Delicate control
4. All of the above

2-2. The requirements referred to in the preceding item are best met by a crane with which type of drive?
1. Hand-operated
2. Gasoline engine
3. Straight electric
4. Electrohydraulic

2-3. The fixed crane found on most aircraft carriers can be described as what type?
1. Rotating king-post with an electro-hydraulic drive
2. Stationary king-post with a straight drive
3. Fixed topping-lift with an electro-hydraulic drive
4. Variable topping-lift with a straight electric drive

2-4. The fixed crane installed on aircraft carrier CVA-60 consists of a cargo hoisting unit, an aircraft hoisting unit, and a rotating unit. Each is driven by a separate electric motor which is operated through a hydraulic pumping system to produce the desired rotary motion.

2-5. Which of the following statements relative to the cargo hoisting unit of the fixed crane used on aircraft carrier CVA-61 is correct?
1. It has a four-part purchase arrangement, is rigged with a 1 1/8-inch diameter wire rope, and its reducer drives a single grooved spooling drum
2. It has a two-part purchase arrangement, is rigged with a 3/4-inch diameter wire rope, and its reducer drives a single grooved spooling drum
3. It has a four-part purchase arrangement, is rigged with a 3/4-inch diameter wire rope, and its reducer drives a pinion gear meshing with the main rotating gear
4. It has a two-part purchase arrangement, is rigged with a 1 1/8-inch diameter wire rope, and its reducer drives a pinion gear meshing with the main rotating gear

2-6. Assuming that the carrier referred to in the preceding item is on even keel, approximately how long should it take for the crane to move a 50,000-pound load one-fourth revolution?
1. Less than 1/4 minute
2. Between 1/4 and 1/2 minute
3. Between 1/2 and 3/4 minute
4. Between 3/4 and 1 minute

2-7. Refer to figure 2-9 in your textbook. If a crane signalman, while facing the crane operator, extends his right hand horizontally and holds it in a rigid open position with palm down, what is he signaling the operator to do?
1. STOP
2. LOWER THE LOAD
3. SWING THE BOOM TO THE LEFT
4. SWING THE BOOM TO THE RIGHT

2-8. Mobile cranes were designed primarily for salvage and rescue operations both aboard ship and at shore stations.

2-9. Upon what is the maximum performance of the crane directly dependent?
1. The ability of its operator
2. The frequency and scope of its maintenance
3. The frequency and scope of its preoperational checks
4. All of the above

2-10. How does the NS-60 crane differ from the NS-50 crane?
1. Its boom is shorter
2. Only its boom is longer
3. Its lifting capacity is greater
4. Its boom is longer, and it has a greater lifting capacity

● Items 2-11 through 2-15 refer to the NS-50 mobile crane.

2-11. Direct current (dc) is used by the crane for powering which of the following?
1. Its hook
2. Its boom
3. Its wheels
4. All of the above

2-12. If the ac generator of the crane fails while an aircraft is being lifted, the crane will
1. drop the aircraft
2. lower the aircraft slowly
3. continue hoisting the aircraft
4. hold the aircraft stationary

2-13. If you are required to lower the NS-50 until its boom rests on the deck, what overall length will be needed?
1. 23 ft
2. 35 ft
3. 58 ft
4. 71 ft

2-14. Which of the following statements regarding the NS-50 is correct?
1. When three-part line reeving is used, the greatest load can be lifted
2. When the hook is reeved to allow a travel of 75 feet per minute, the swivel hook and block assembly may be used
3. The light capacity hook has approximately 7 percent greater load capacity than the swivel hook and block assembly
4. When two-part line reeving is used, the crane can lift a maximum of 50,000 pounds

2-15. The only difference between the first and second methods of hook line reeving is that the first utilizes a
1. single-part line and the second a two-part line
2. two-part line and the second a single-part line
3. 15,000-pound hook and the second a 50,000-pound hook
4. 50,000-pound hook and the second a 15,000-pound hook

2-16. If a crane is equipped with warning lights on the instrument panel to indicate some abnormal condition of the machine, their coming on could indicate abnormalities in which of the following?
1. The brake system
2. The cooling system
3. The drive wheel motors
4. Any of the above

2-17. Which of the following safety precautions must be observed when personnel operate or service a crane?
1. The personnel assigned must be fully qualified
2. An operator must always be in the cab when the crane is being operated remotely
3. If the crane is left unattended, all electrical switches must be in the OFF position
4. All of the above

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Learning Objective: Indicate uses of hoisting slings and applicable maintenance and inspection procedures.

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2-18. Hoisting slings are used aboard aircraft carriers and at naval air stations for what purpose(s)?
1. Lifting aircraft from a pier or barge onto a carrier
2. Lifting aircraft for the performance of maintenance
3. Moving aircraft and equipment
4. All of the above

2-19. An aircraft's hoisting-sling, load-bearing cable must be replaced if visual inspection reveals which of the following defects?
1. A deformation resulting from a pulled through kink
2. Six or more broken wires in any 9-inch length
3. The presence of excessive corrosion
4. Any of the above

2-20. When a sling has been successfully static tested to 1 1/2 times its working load, a metal tag should be attached to it to indicate all but which of the following?
1. The estimated breaking strength
2. The date of the proofload test
3. The date for the next proofload test
4. The name of the proofload testing activity

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Learning Objective: Identify uses of the NT-4 tow bar and the source of information relating to the type of tow bar to use with a particular aircraft.

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2-21. The NT-4 tow bar, designated as a universal tow bar, can be used for towing which of the following aircraft?
1. All fixed-wing aircraft
2. All carrier-based aircraft
3. All aircraft equipped with nosewheel or tailwheel axle tow holes
4. All of the above

2-22. The NT-4 tow bar can be used to tow a y aircraft if it is equipped with which of the following?
1. Fuselage tow rings
2. Landing gear tow rings
3. Nosewheel axle tow holes
4. Any of the above

2-23. Where can you find information concerning the tow bar to be used with a particular aircraft?
1. The Pilot's Handbook for that type of aircraft
2. The Aircraft Flight Manual for that type of aircraft
3. The Maintenance Instructions Manual for that type of aircraft
4. The Illustrated Parts Breakdown for that type of aircraft

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Learning Objective: Recognize the use of the universal chock, the capacity of the TD-1A tiedown, and the ABH's concern for using manila and nylon tiedowns.

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2-24. The universal chock used aboard aircraft carriers is adjustable to fit any landing gear wheel up to 45 inches in diameter.

2-25. What is the maximum load capacity of the TD-1A tiedown?
1. 10,000 lb
2. 12,000 lb
3. 36,000 lb
4. 90,000 lb

2-26. Inasmuch as the weight of modern aircraft has increased to the point that nylon and manila line are no longer practical for use as tiedowns, the ABH does NOT need to concern himself with their use.

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Learning Objective: Recognize ways of preventing handling equipment failure, and relative to corrosion, identify causes, methods of detection, and corrective procedures.

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2-27. Most equipment failure can be prevented by adherence to proper operating procedures supplemented by a continuous preventive maintenance program.

2-28. Why is carrier-based handling equipment particularly susceptible to corrosion?
1. Because the stresses placed on the equipment are severe
2. Because the alloys used in the equipment corrode easily
3. Because of the presence of moisture which is essential to corrosion
4. Because of all of the above

2-29. A pitted surface surrounded by a white or gray powdery deposit indicates the presence of corrosion on
1. steel
2. copper
3. titanium
4. aluminum alloy

2-30. The first step to take when corrosion is discovered on the surface of a piece of aircraft handling equipment is to assess the extent of the damage so that you can determine whether to repair or to replace the affected surface.

2-31. Whether to remove a corrosion deposit from a structural part of a piece of aircraft handling equipment or to completely replace the affected part depends on which of the following?
1. The availability of replacement parts
2. The capability to repair or to replace
3. The degree and extent of the corrosion
4. All of the above

Learning Objective: Identify safety responsibilities applicable to senior ABHs.

2-32. The safety responsibilities of the ABH1 or ABHC require that he be able to do which of the following?
1. Interpret safety directives
2. Provide his men with safety precautions verbally or in written form
3. Impress on his men the importance of following safe practices
4. All of the above

2-33. Which expression would be particularly applicable to personnel who maintain or operate aircraft handling equipment?
1. Experienced
2. Authorized
3. Assigned
4. Both 2 and 3 above

Learning Objective: Recognize personnel assignments, responsibilities, safety considerations, and precautions applicable to handling aircraft at naval air stations.

2-34. Which of the following officers is the department head of the line division of a large naval air station?
1. Aircraft maintenance officer
2. Aircraft control officer
3. Operations officer
4. Either 2 or 3 above

2-35. As senior petty officer of the line division aboard a naval air station, you are responsible for the operation of all assigned aircraft and handling equipment on the line.

2-36. Which of the following is NOT a major duty of a senior ABH assigned to the line of a naval air station?
1. Training and supervising plane directors
2. Maintaining flight records as required
3. Scheduling administrative and proficiency flights
4. Enforcing all safety precautions applicable to flight line operations

2-37. Your duties as an ABH1 or ABHC assigned to the terminal at a naval air station will require you to have a thorough knowledge of aircraft cargo weight limitations and distribution and of the security procedures used in cargo handling.

2-38. As the senior petty officer assigned to a line division, you should stress to your taxi signalmen the importance of giving definite and precise signals in order to eliminate any possibility of misunderstanding and to give the pilot confidence in the signalmen.

2-39. Taxi signalmen must be taught that during the taxiing of an aircraft under their direction they must maintain a position whereby the pilot's eyes can be seen at all times.

2-40. An aircraft must have at least two taxi signalmen in attendance if the clearance in the taxi area is less than
1. 50 feet from the right wingtip
2. 35 feet from the left wingtip
3. 40 feet from any portion of the aircraft
4. 25 feet from any portion of the aircraft

2-41. Before you are allowed to operate any of the self-propelled vehicles used on the line, you must meet which of the following requirements?
1. Be a petty officer
2. Possess a valid government driver's license
3. Have attended a formal course of instruction on aircraft support equipment
4. Both 2 and 3 above

2-42. Specific instructions concerning aircraft towing are issued by most local aviation activities. What should these local instructions include with respect to aircraft towing?
1. The operator of the tow vehicle possess a valid government driver's license
2. The man operating the aircraft brakes be familiar with the type of aircraft
3. All ground safety locks be installed
4. All of the above

2-43. Before towing an aircraft equipped for nosewheel steering, you should disengage the cockpit steering system if the aircraft is to be towed by its
1. fuselage
2. nosewheel
3. tailwheel
4. main landing gear

2-44. A qualified man in the cockpit is required when an aircraft is being spotted on the line by which of the following methods?
1. Manual handling
2. Tow tractor
3. Its own power
4. All of the above

2-45. When tying down aircraft at a naval air station, what determines how they will be secured?
1. The expected weather conditions
2. The type of tiedown equipment available
3. The number of tiedown pad eyes on the ramp
4. The number of aircraft to be secured

2-46. During a daily inspection of line fire extinguishing equipment you find a yellow-banded, 50-pound extinguisher on a yellow cart. What conclusion can you make?
1. It is a foam-type extinguisher mounted on a $CO_2$ cart
2. It is a $CO_2$ extinguisher mounted on a foam-type cart
3. It is a $CO_2$ extinguisher mounted on its proper cart
4. It is an FCDC extinguisher mounted on its proper cart

2-47. Who is directly responsible for ascertaining that all line personnel are trained in fire prevention, fire protection measures, and the use of firefighting equipment?
1. The line division officer
2. The station fire chief
3. The section leaders
4. The line chief

2-48. Which fire extinguishing agent is most commonly used on small line fires?
1. $CO_2$
2. FCDC
3. Foam
4. Purple-K-Powder

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Learning Objective: Recognize personnel assignments and responsibilities, requirements, safety precautions, and procedures applicable to handling aircraft in all phases of carrier operations.

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2-49. Aside from the fact that effective air operations aboard a carrier are the result of team effort, the number of aircraft that can be launched and recovered in a given time is determined primarily by the efficiency of the plane directors.

2-50. The handling of all aircraft aboard an aircraft carrier is performed by V-1 and V-3 division personnel under the direction of the
1. flight deck officer
2. aircraft handling officer
3. hangar deck officer
4. senior AB assigned to each division

2-51. During flight operations, the flight deck officer position is normally manned by the
1. V-1 division officer
2. V-1 assistant division officer
3. V-3 division officer
4. aircraft handling officer

2-52. As the flight deck chief aboard a carrier, what are you responsible for?
1. The training of all plane directors
2. Operations on the flight deck
3. The enforcement of all safety precautions pertinent to the movement of aircraft
4. All of the above

2-53. All of the following are duties of the flight deck chief petty officer except
1. conducting a training program in the handling of aircraft
2. supervising aircraft maintenance personnel on the flight deck
3. supervising aircraft handling equipment maintenance personnel on the flight deck
4. enforcing the flight deck uniform regulations for personnel in all divisions

2-54. The ABH assigned the duties as flight deck leading petty officer must familiarize himself with the duties of the flight deck chief petty officer and assume those duties during his absence.

2-55. The hazards and dangers involved with flight deck operations can be minimized if you, as the senior ABH, ascertain that a sound command policy, proper training principles, standard operating procedures, and a continuous safety program are carried out by all personnel involved.

2-56. The teamwork necessary in all aspects of flight operations aboard a carrier makes obvious the fact that one important element of efficient and safe operations is discipline.

2-57. Having a copy of the operations flight schedule is very important to the ABH because he must rely on it for which of the following information?
1. Launch priority and sequence
2. Launch and recovery time
3. The number and type of aircraft in each launch
4. All of the above

2-58. The number of aircraft to be launched in a one-day operation is based on the
1. number of aircraft embarked
2. number of aircraft that can be serviced within a given period of time
3. number of aircraft that are available when the schedule is originated
4. predicted number of aircraft that will be available

2-59. Approval must be obtained from which of the following to make any change to the flight schedule once it has been approved and issued?
1. The squadron maintenance officer
2. The ship's air department
3. The ship's operations department
4. The aircraft handling officer

2-60. In planning the spot for the various types of aircraft aboard, you must bear in mind that some types must be spotted in a specific location each time for which reason(s)?
1. Servicing
2. Maintenance or for starting
3. Loading ammunition and for preventing interference with the movement of other aircraft
4. All of the above

2-61. For what reason should you inform your spotters to spot all jet aircraft heading as near as possible into the wind?
1. To prevent fires or hot starts
2. To ensure they are in a ready position for the catapult
3. To allow the engine exhaust to be blown over the side
4. To ensure that the GO aircraft are in the front rows

2-62. Where are jet aircraft to be spotted on the flight deck?
1. On the aft end with the first-to-be-launched aircraft forward
2. On the aft end with the first-to-be-launched aircraft aft
3. Along the deck edge with the first-to-be-launched aircraft forward
4. Along the deck edge with the first-to-be-launched aircraft aft

2-63. During a prelaunch briefing, what information should pertinent personnel expect to receive from the aircraft handling officer?
1. The disposition of aircraft that go DOWN during the launch
2. The details for recovery of the aircraft
3. The specific procedures and sequences for the launch
4. All of the above

2-64. The most experienced and capable directors should be assigned as catapult spotters because
1. the speed of approach of an aircraft to the catapult and its position on it are critical to fast and safe launching
2. they are not likely to permit the holdback to stop the aircraft
3. the closeness of the next aircraft awaiting its turn to be spotted prevents any repositioning of a plane on the catapult
4. their authority in spotting cannot be questioned or shifted to anyone else as long as a plane is on the catapult

2-65. Which of the following factors will determine the procedure for removing a downed aircraft from a catapult during a launch?
1. The flight deck layout
2. The number of remaining aircraft to be launched
3. The space available on either the flight deck or hangar deck, or both
4. All of the above factors

2-66. What is the "foul line" on a carrier's flight deck?
1. The line marking off an area to be used only for spotting aircraft that are damaged in landing
2. The line drawn down the center of the landing area
3. The line separating the landing area from the rest of the deck
4. The line marking off an area for parking tow tractors and handling equipment

2-67. Immediately after an aircraft's recovery and release from the arresting gear wire, who directs the aircraft clear of the landing area?
1. The spotting director
2. The plane captain
3. The fly three director
4. The flight deck officer

2-68. During the recovery phase of flight operation, tow tractors are kept in a ready condition to remove all landing aircraft from the landing area.

2-69. Who has the responsibility for determining if servicing and maintenance on an aircraft should be interrupted in the interest of flight operations aboard a carrier?
1. The flight deck leading PO
2. The plane director
3. The flight deck officer
4. The aircraft handling officer

2-70. Assuming the landing area is NOT involved, one serious consequence of an aircraft elevator casualty during flight recovery operations is the creation of problems that arise because of the
1. fact that when one elevator has a casualty all the others are similarly affected
2. altered procedure for spotting aircraft
3. complexity of elevator repair procedures
4. altered procedure for launching aircraft

2-71. A prime prerequisite for safe and efficient flight deck operations is accurate, disciplined communications.

# Assignment 3

Aircraft Handling, Crashes, Firefighting, and Crew Entrapment

Text: Pages 46 - 75

Learning Objective (Continued): Recognize personnel assignments and responsibilities, requirements, safety precautions, and procedures applicable to handling aircraft in all phases of carrier operations.

3-1. First and foremost of the safety requirements applicable to the flight deck that the flight deck chief must enforce is the use of standard taxi signals by the directors to prevent confusion to the pilot.

3-2. Because of the decrease in the tempo of operations, all new personnel in your division should be assigned night duties if possible in order to help lessen the accident potential on the flight deck.

3-3. Inasmuch as the safety of crew and equipment on a flight deck is the responsibility of the ABH1 or ABHC in charge, he should stress and emphasize safety to the point that it becomes routine rather than the exception with all personnel concerned.

3-4. What must all members of a flight deck crew wear?
1. Goggles
2. Flight deck life preservers
3. Sound attenuating protective helmets
4. All of the above

3-5. Why is spotting aircraft on the hangar deck sometimes a tedious operation?
1. Because of the lack of enough room for tow tractors to maneuver effectively
2. Because of the close quarters and irregular shape of the deck
3. Because of the need for maintaining separation between UP and DOWN aircraft
4. All of the above

3-6. Operation of the aircraft elevators is a responsibility of the
1. V-1 division only
2. V-3 division only
3. V-1 and V-3 divisions jointly
4. either the V-1 or V-3 division, depending on the ship's organization

3-7. ABHs assigned to the V-3 division will most likely be assigned to either supervise or perform which of the following jobs?
1. Operate the carrier's aircraft elevators
2. Move aircraft on the hangar deck
3. Man the firefighting equipment assigned to the hangar deck
4. Any of the above

3-8. If an F-4B aircraft is inadvertently placed on the wrong elevator when being moved from the hangar deck to the flight deck, who is responsible?
1. The plane captain
2. The hangar deck chief
3. The aircraft handling officer
4. The hangar deck officer

3-9. The objective of operational spotting of aircraft is to improve which of the following aspects of carrier operations?
1. Flight deck operations
2. Air department operations
3. Hangar deck maintenance
4. Both 1 and 2 above

3-10. Inattention to duty by personnel fueling and defueling aircraft that are closely spotted on the hangar deck could result in structural damage resulting from which of the following?
1. Fuel tank openings being blocked
2. A wing raising during a defueling operation
3. A wing lowering during a fueling operation
4. Either 2 or 3 above

3-11. The greatest problems encountered by hangar deck personnel have to do with operational spotting of aircraft for maintenance on the hangar deck.

3-12. An aircraft should never be moved on the hangar deck until it has been ascertained that
1. a qualified plane captain is in the cockpit
2. the trailing edges of the wings have been padded
3. safety men have been assigned to the nose, tail, and wingtips
4. a qualified plane captain is in the cockpit and he has been notified that the aircraft is to be moved

3-13. Which of the following procedures requires that the area in which the aircraft is located be blocked off?
1. Defueling the aircraft
2. Turning up the aircraft on the hangar deck
3. Moving the aircraft when the carrier is in a tight turn
4. Performing hangar deck maintenance which precludes aircraft movement

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Learning Objective: Recognize operating equipments, personnel assignments and duties, and procedures for handling aircraft on LPHs, LPDs, and LHAs.

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3-14. What types of operating equipment do LPHs and LPDs use to accomplish their mission?
1. Landing craft
2. Transport helicopters
3. Amphibious vehicles
4. All of the above

3-15. On the LHAs, the centerline elevator can handle helicopters with a maximum gross weight of
1. 20,000 lb
2. 28,000 lb
3. 30,000 lb
4. 38,000 lb

3-16. The CH-54 (Flying Crane) helicopter is too large to fit on the hangar deck of an LHA.

3-17. The duties of an ABH assigned to an LPD are identical to those he would have in either the V-1 or V-3 divisions of an aircraft carrier.

3-18. Since shipboard handling of helicopters during night operations is the most critical time for both handling crew and pilots, strict adherence to all pertinent measures and the utilization of standard night procedures and signals are mandatory for all concerned.

3-19. A director must NOT signal a helicopter pilot to take off or land prior to receiving appropriate instructions from PriFly.

3-20. What visual display is made at fly control to give the command "Launch helicopter(s)"?
1. A red flag and a red light
2. A green flag and a green light
3. A green flag and a red light
4. A red flag and a green light

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Learning Objective: Recognize the basic requirements for fighting aircraft and structural fires, their differences in methods and materials, and the primary duty of crash crewman.

---

3-21. Determine whether each of the following statements is true or false; then select the alternative below which lists those that are true.
A. ____Firefighting in aircraft crashes requires skill, intelligence, and training on the part of crash crew personnel.
B. ____Because human life is involved, speed is absolutely essential in extinguishing aircraft fires.
C. ____Structural fires present greater hazards to the firefighter in the form of sudden combustion, flashbacks, and restricted work area than do aircraft fires.
1. A and B
2. A and C
3. B and C
4. A, B, and C

3-22. Inasmuch as there are differences in the types of fires as well as in the methods of extinguishment, a crash crew employs vehicles, extinguishing agents, and tools NOT ordinarily employed by a structural fire crew.

3-23. The primary duty of a crash crewman is to extinguish and limit the damage of the fire.

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Learning Objective: Recognize responsibilities of individuals as they relate to aircraft fire-fighting and rescue operations, and indicate applicable training requirements.

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3-24. The basic criteria for the fire department at a naval air facility are established by the Naval Air Systems Command; but the responsibility for their implementation belongs to the
1. commanding officer
2. operations officer
3. security officer
4. fire chief

3-25. Which of the following statements delineates the area of operational control when there is a crash fire at a naval air facility?
1. The station fire chief controls the operations in the immediate area of the crash fire
2. The air operations officer assumes overall control except the immediate area of the crash fire
3. The air operations officer assumes overall control until operations are back to normal
4. The area of control is delineated in both 1 and 2 above

3-26. A responsibility of the fire chief to squadron personnel on temporary duty at an air station is to give them
1. basic first aid practice
2. rescue procedures training
3. structural firefighting instruction
4. fire prevention and protection instruction

3-27. Personnel engaged in which of the following duties incidental to aircraft operations will be instructed in types of fire extinguishers and their operation, care, and proper application to any type of fire that might occur on the flight line?
1. Fueling
2. Servicing
3. Maintenance
4. All of the above

3-28. A comprehensive training program should include instruction and training on actual burning aircraft in simulated aircraft fire emergencies.

3-29. Which of the following are requirements for crash-rescue training in which aircraft crashes and/or fires are simulated?
1. A training area located so that flight operations are not hampered but where personnel are readily available in the event of an emergency
2. Exercises where entry into the aircraft must be forced
3. The extensive use of training manuals, directives, films, visual aids, and other training aids
4. All of the above

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Learning Objective: Recognize types and applications of aircraft fire/rescue emergency communications systems, and indicate proper notification procedures in the event of a crash.

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In items 3-30 through 3-33, select from column B the emergency communications system provided each activity/unit listed in column A.

| A. Activities/Units | B. Emergency Communications Systems |
|---|---|
| 3-30. Airfield operations office | 1. Fire/rescue network |
| 3-31. Air operations dispatcher | 2. Primary crash alarm system |
| 3-32. Duty officer's office | 3. Secondary aircraft emergency intercommunications system |
| 3-33. Runway foamer/nurse truck | |

3-34. In addition to radio equipment, a direct wire intercommunication system is installed in several locations for what purpose(s)?
1. For notifying the operations dispatcher so that he may in turn notify all essential supporting activities
2. For notifying all essential personnel and activities simultaneously
3. To afford an immediate means of communicating with primary emergency activities
4. Both 1 and 3 above

3-35. The commanding officer is notified of a crash by the
1. control tower operator using the regular telephone
2. control tower operator using the primary crash alarm intercommunications system
3. air operations duty office using the secondary alarm intercommunications system
4. duty officer using the regular telephone

3-36. Who is notified of a crash at the same time as the crash-truck crew and ambulance crew?
1. The commanding officer
2. The station duty officer
3. The operations dispatcher
4. The operations duty officer

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Learning Objective: Relative to the various kinds of alert crews, recognize conditions of readiness; duties; personnel requirements, qualifications, and participation categories; minimum response requirements; and vehicles utilized.

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3-37. Which of the following conditions of readiness maintained during flight operations requires personnel be located in a position that will permit rapid rescue of personnel involved in unannounced emergencies?
1. Standby alert
2. Runway alert
3. Backup standby alert
4. All of the above

3-38. Refer to table 4-1 in your textbook. What is the minimum water and foam generation requirement that must be immediately available for flight operations at a naval air station if these operations involve aircraft having a gross weight of 75,000 pounds?
1. 400 gallons of water, 200 gallons of foam per minute
2. 1,000 gallons of water, 400 gallons of foam per minute
3. 1,200 gallons of water, 750 gallons of foam per minute
4. 2,400 gallons of water, 1,000 gallons of foam per minute

3-39. Who must remain in the immediate vicinity of their vehicles during flight operations?
1. The crash ambulance personnel
2. Ordnance disposal crew personnel
3. The runway and standby alert crash-rescue vehicle personnel
4. All of the above personnel

3-40. What are the standard crash-rescue vehicles?
1. Crash ambulances
2. MB-2 and 06 carbon dioxide truck
3. MB-1 and MB-5
4. All of the above

3-41. In an activity which supports costly and intricate electronic equipment, which of the following must be added to the regular complement of firefighting and rescue vehicles?
1. Aircraft salvage crane
2. 06 carbon dioxide truck
3. Water tanker/runway foamer
4. Truck-mounted TAU

---

In items 3-42 through 3-45, select from column B the participation category into which each group of personnel authorized to attend or participate in crash-rescue emergencies listed in column A is placed.

| A. Personnel Groups | B. Participation Categories |
|---|---|
| 3-42. Accident board members | 1. Standby alert-immediate availability |
| 3-43. Ambulance crew | 2. Support |
| 3-44. Security personnel | |
| 3-45. Fire-rescue crew | 3. Administrative |

3-46. More than two men are required to man which of the following standard fire/rescue vehicles?
1. MB-5
2. Nurse truck
3. Truck-mounted TAU
4. 06 carbon dioxide truck

3-47. The number of men required to man aircraft fire/rescue vehicles to meet minimum response requirements is dependent upon the number of days a week and hours a day the pertinent activity is open to flight operations.

3-48. In addition to being in good physical condition, men assigned to aircraft fire/rescue duties must also possess which of the following?
1. The capability to assess a fire situation
2. Initiative
3. Resolution
4. All of the above

3-49. Assignment of qualified personnel to fire/rescue duty should be made for a minimum of two years, and their rotation should be arranged so that at least one-half of the on-duty personnel will have had no less than eight months' experience in the assignment.

3-50. In view of the fact that decisions as to the best methods of effecting personnel rescue and of extinguishing fires must be made at the scene of a crash, it is imperative that the fire/rescue personnel not only be familiar with the type of aircraft involved but must also have knowledge of which of the following?
1. The fire location and degree of fire involvement
2. The number of personnel and their stations
3. The presence and types of ordnance stores aboard
4. All of the above

3-51. Who normally determines the rescue/fire operations at the scene of a crash?
1. The crash fire chief
2. The station fire chief
3. The air operations duty officer
4. The runway alert driver-operator

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Learning Objective: Recognize proper positioning of vehicles and personnel in relation to aircraft crashes and why these positions are used.

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3-52. What is the basic vehicle position in relation to a crashed aircraft?
1. At the nose
2. At the tail
3. At either wingtip
4. 1 or 2 above

3-53. Why should crash/firefighting vehicles be positioned upwind from a burning aircraft rather than any other position?
1. Fuel vapors will drift away on the wind
2. Firefighters will not be subjected to as much heat
3. The seat of the fire can be more easily located as the smoke will be blowing in the opposite direction
4. All of the above

3-54. From which direction should rescue personnel approach a burning fighter aircraft that is equipped with rockets?
1. From one of the quarters
2. From the rear
3. From the front
4. Either 1 or 2 above

3-55. If a burning aircraft is located on sloping ground, the crash/rescue vehicle should be positioned uphill from it because liquid fuels and vapors flow toward an elevation lower than their source.

3-56. In which direction should a rescueman face while lifting an injured or unconscious airman from the cockpit of a crashed aircraft?
1. Aft
2. Forward
3. Facing the man
4. Either 1 or 2 above, depending on the location of the crash/rescue vehicle

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Learning Objective: Recognize methods used to prevent backflash from aircraft fuel fires, distribution of the formal fire report, and preplanning requirements for an offstation crash.

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3-57. Although $CO_2$ is extremely effective in smothering fires, in order to avoid backflash and to counter the effect of wind, how should it be used?
1. On nonelectrical fires only
2. In conjunction with foam for fuel fires
3. In a heavy concentration rather than being widely dispersed
4. In closed areas only

3-58. The vehicle-mounted twinned agent unit (TAU) provides light water for quick extinguishment of aircraft fuel fires and dry chemical to cover the fire and prevent backflash.

3-59. Refer to figure 4-6 (A through D) in your textbook. This report must be completed within 72 hours following an aircraft emergency by the activity to which the crash/rescue organization is attached. The original of this report must be sent to
1. CNO
2. NAVSAFCEN
3. NAVAIRSYSCOM
4. the pertinent military command

3-60. In order to locate and reach an offstation crash within a minimum time with as much fire rescue equipment, medical equipment, and personnel as may be needed, a grid map of approximately a 15-mile radius from an air station must be maintained in the operations office, air traffic control tower, crash fire and fire stations, hospital, and security office.

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Learning Objective: Recognize design and operating characteristics of the MB-1 truck, who is responsible for the truck and its crew, and the station of the turret operators while proceeding to a fire.

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3-61. The truck has a water and foam capacity of how many gallons?
1. 400 gallons of water and 25 gallons of foam concentrate
2. 400 gallons of water and 65 gallons of foam concentrate
3. 1,000 gallons of water and 32 1/2 gallons of foam concentrate
4. 1,000 gallons of water and 65 gallons of foam concentrate

3-62. Determine whether each of the following statements concerning the MB-1 truck is true or false, then select the alternative below which lists those that are true.

A.____A most significant feature of the truck is its twin independent foam making system.

B.____It is capable of fairly rapid acceleration and fast speeds despite its 36,000-pound weight when fully loaded.

C.____An important asset of the truck is that it carries an independent gasoline-powered generator to provide power for heating, lighting, and communications.

1. A and B
2. A and C
3. B and C
4. A, B, and C

3-63. Assume that foam is no longer needed from the MB-1 turret nozzles and the operators reposition their air pressure controls so that turret A is positioned to OFF and turret B is stopped at an intermediate position between ON and OFF. Which of the following statements relative to this situation is correct?
1. Turret A will stop spraying; turret B will spray water
2. Turret A will spray water until the nozzle is clean, and then the spray will cease; turret B will spray water until the control is positioned to OFF
3. Both turrets will cease spraying since the turret A control has an override feature
4. Both turrets will continue to spray foam until turret B's control is positioned to OFF

3-64. Why should water be flushed through the turret nozzles on the MB-1 truck?
1. To remove the foam from the nozzles
2. To prevent foam concentrate from clogging in the piping
3. To stop the formation of foam-caused corrosion
4. All of the above

3-65. Who is individually responsible for the safety of the crew and the equipment and the readiness of both at all times?
1. The driver
2. The crash captain
3. The crash fire chief
4. The MB-1 safety monitor

3-66. If you are the starboard turret operator, where are you stationed while proceeding to a fire?
1. On the turret
2. In the driver's compartment
3. In the rear tank compartment
4. In the pump engine compartment

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Learning Objective: Recognize construction features and operating characteristics of the MB-1A and MB-5 trucks, and the firefighting agents carried and their uses.

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3-67. The primary fire extinguishing agent used on the MB-1A truck is
1. foam
2. water
3. $CO_2$
4. P-K-P

3-68. What is the maximum foam discharge capacity for the MB-1A truck?
1. 5,000 gpm
2. 6,000 gpm
3. 6,500 gpm
4. 7,200 gpm

3-69. The handline located on the MB-1A fire/rescue truck can provide a foam discharge of 36 gallons per minute.

3-70. A 150-pound stationary dry chemical system with a 100-foot handline is a part of the fire fighting equipment on the MB-1A fire/rescue truck which uses potassium bicarbonate to extinguish a fire.

3-71. Although the MB-5 crash-rescue truck is equipped primarily for fighting fires with foam, it is also equipped for fighting fires with which of the following?
1. $CO_2$
2. Purple-K-Powder
3. Light water
4. Both 1 and 2 above

3-72. The dry chemical extinguisher carried on the truck is effective in fighting which type(s) of fire(s)?
1. Tire fires
2. Fuel fires
3. Wheel fires
4. All of the above

3-73. Although the MB-5 truck's handline operator can stop and start the flow through the line by the control at the nozzle, where is the selection of the solution that flows through the handline controlled?
1. From the roof of the cab
2. In the cab
3. At the curbside valve housing
4. At the handline quick disconnect located near the hose reel compartment

3-74. Although the Oshkosh MB-5 truck has the capacity for holding a greater amount of each, it is recommended that it be filled with
1. 400 gallons of water and 30 gallons of agent concentrate
2. 420 gallons of water and 34 gallons of agent concentrate
3. 1,000 gallons of water and 65 gallons of agent concentrate
4. 3,000 gallons of water and 200 gallons of agent concentrate

3-75. In adition to its regular turret supply and handline supply systems, the Oshkosh MB-5 carries three portable P-K-P fire extinguishers.



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# Assignment 4

Aircraft Crashes, Firefighting, Crew Entrapment and Chain Arresting Gear

Text: Pages 75 - 105

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Learning Objective: Identify the functions of a nurse truck and who makes decisions and notifies crew personnel concerning the use of foaming operations, and indicate related information that should be furnished the crash captain.

4-1. The "nurse" truck performs which of the following functions?
1. It replenishes MB-1 and MB-5 vehicles at the scene
2. It foams the runway
3. It provides auxiliary extinguishing agents
4. Both 1 and 2 above

4-2. Information concerning an anticipated runway foaming is passed to the runway foam truck by whom?
1. Control tower personnel only
2. The operations duty officer only
3. The crash captain
4. Both 1 and 2 above

4-3. Based on information available, such as the crash equipment available, the prevailing weather or the time required to foam a runway, the decision to foam the runway is made by the
1. operations duty officer
2. safety officer
3. crash captain
4. pilot

4-4. The information given to the crash captain for foaming a runway should include all but which of the following?
1. The time limit the aircraft can remain airborne
2. The designation of the runway to be foamed
3. The expected landing gear condition of the aircraft
4. The primary crash-rescue vehicles to be used

Learning Objective: Recognize the operational characteristics and uses of a twinned agent unit (TAU) fire extinguisher and the effects of using it.

4-5. A TAU fire extinguisher would be very effective in fighting which of the following fires?
1. Burning electrical insulation
2. A fire within an electrical generator
3. Burning jet fuel
4. All of the above

4-6. How does the TAU fire extinguisher affect a fire?
1. The light water and dry chemical (P-K-P) combine to act as an extinguishing agent
2. The light water and P-K-P combine to act as a vapor securing agent
3. The P-K-P acts as an extinguishing agent, and the light water acts as a vapor securing agent
4. The P-K-P acts as a vapor securing agent, and the light water acts as an extinguishing agent

4-7. After approaching a fire from upwind, what is the first step you should take to extinguish the fire with a TAU fire extinguisher?
1. Direct the P-K-P on the base of the flames
2. Direct the light water on the base of the flames
3. Direct the mixture of P-K-P and light water directly into the flames
4. Direct the mixture of P-K-P and light water on the base of the flames

4-8. The TAU fire extinguisher should be used on internal and accessory sections of jet engines and electrical equipment only as a last resort for what reason(s)?
1. The P-K-P is very difficult to remove
2. The P-K-P may restrict cooling air passages
3. Corrosion may result
4. All of the above

Learning Objective: Identify essential rescue vehicle equipment and how fire rescue clothing should be used and cleaned.

4-9. The first vehicle on the scene of a crash is normally designated as a rescue vehicle and should be equipped with specialized rescue equipment in addition to the basic equipment and emergency entry tools carried by all Navy crash trucks.

4-10. Aluminized clothing must be worn by rescue personnel who forcibly enter burning aircraft to rescue entrapped and/or injured airmen.

4-11. What should be used to remove grease stains from aluminized clothing?
1. Soap and water
2. Dry cleaning solvent
3. Abrasive cleaner
4. Any of the above

4-12. What should be used to clean foam from aluminized clothing?
1. Isopropanol
2. An approved corrosive chemical
3. Perchloroethylene
4. Mild soap and water

Learning Objective: Indicate the qualifications and duties of members of a flight deck crash/salvage team and the functions of equipments they use.

4-13. In addition to rescuing personnel from crashed and/or burning aircraft on the flight deck and fighting flight deck fires, the crash salvage team also performs what other function(s)?
1. It clears away wreckage
2. It administers emergency first aid
3. It makes emergency flight deck repairs
4. All of the above

4-14. A crash/salvage team should be trained to the extent that each man on the team is qualified to perform the functions of every other member of the unit.

In items 4-15 through 4-19, select from column B the type of crash equipment that would be normally used for each function listed in column A.

| A. Functions | B. Equipments |
|---|---|
| 4-15. Lifting and "walking off" with any carrier aircraft | 1. Slings |
| 4-16. Lifting one portion or side of an aircraft at a time | 2. Dollies |
| 4-17. Moving heavy aircraft components | 3. Cranes |
| 4-18. Lifting aircraft in other than the normal three-point attitude relative to the deck | 4. Forklifts |
| 4-19. Cradling landing gear strut for moving the aircraft | |

Learning Objective: Relative to the shipboard twinned agent unit (SBTAU), identify capacities, functions, sizes of components, operational features, and safety features.

4-20. When fully charged, the capacities of the light water container and the dry chemical container are
1. 80 gallons and 200 pounds, respectively
2. 200 gallons and 80 pounds, respectively
3. 230 gallons each
4. 230 pounds each

4-21. Both P-K-P and light water are expelled from their respective tanks by nitrogen gas whose pressure is reduced to 230 psig.

4-22. Which of the following components is protected by a pressure relief valve set at 250 psig?
1. The dry chemical container
2. The light water container
3. The pressure regulator
4. Each of the above

4-23. Which of the following statements relative to the sizes of the twinned neoprene-lined and neoprene-covered discharge hoses is correct?
1. Both hoses are 3/4 inch in diameter
2. Both hoses are 1 inch in diameter
3. The dry chemical hose is 1 inch in diameter, and the light water hose is 3/4 inch in diameter
4. The dry chemical hose is 3/4 inch in diameter, and the light water hose is 1 inch in diameter

4-24. What will the pressure gages on the containers indicate when the system is in a "ready" condition?
1. Both will indicate zero
2. Both will indicate 230
3. The dry chemical container gage will indicate 80, and the light water container gage will indicate 200
4. The dry chemical container gage will indicate 200, and the light water container gage will indicate 80

4-25. Five gallons of light water concentrate, MIL-F-23905(B), when properly mixed with water will result in how many gallons of light water solution?
1. 60 gal
2. 75 gal
3. 80 gal
4. 90 gal

4-26. When P-K-P and light water are being used on a fire simultaneously, a mixture of nitrogen and P-K-P is discharged through the dry chemical nozzle, but only light water is forced out of the light water nozzle until the solution is exhausted.

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Learning Objective: Recognize proper procedures for using and maintaining the SBTAU.

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4-27. After approaching a fire from upwind, what is the first step you should take to extinguish it?
1. Direct P-K-P on the base of the flames
2. Direct light water on the base of the flames
3. Direct a mixture of P-K-P and light water directly into the flames
4. Direct a mixture of P-K-P and light water on the base of the flames

4-28. What is the proper way to fill the light water container?
1. Put 75 gallons of water into the container and add 5 gallons of light water concentrate
2. Put 5 gallons of light water concentrate into the container and fill with water
3. Alternately put 5 gallons of water and 1 gallon of light water concentrate into the container until it is full
4. Put approximately 50 gallons of water into the container, add 5 gallons of light water concentrate, and then fill with water to within 1 inch of the cap opening

4-29. You must replace the nitrogen cylinder if your daily check reveals that the pressure of the gas has fallen more than 1,700 psig.

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Learning Objective: Recognize the nomenclature and operating procedures for the TAU-3.

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4-30. The TAU-3 fire fighting unit is a self-propelled twin agent fire fighting vehicle.

4-31. The TAU-3 fire fighting unit contains how much fire fighting agent?
1. 400 gal of light water and 200 lb of dry chemical
2. 150 gal of light water and 100 lb of dry chemical
3. 300 gal of light water and 50 lb of dry chemical
4. 400 gal of light water and 400 lb of dry chemical

4-32. How is the dry chemical charged with nitrogen on the TAU-3 fire fighting vehicle?
1. By a two-position lever on the unit's control panel
2. By a pushbutton on the vehicle's dashboard
3. It is charged during filling and never needs recharging
4. By a hand pump located on the unit

4-33. What is the dry chemical average discharge rate of the TAU-3?
1. One pound per second
2. Two pounds per second
3. Three pounds per second
4. Five pounds per second

Learning Objective: Indicate the rescue and jettisoning procedures used in flight deck crashes, including associated problems, and recognize the primary objective of rescue personnel.

4-34. Even though an aircraft is NOT on fire when it comes to rest after an on-deck crash, it must be approached by the rescue crew as if it were on fire.

4-35. What is normally the first objective of the rescue crew whenever an on-deck crash occurs?
1. To rescue personnel
2. To extinguish all fires
3. To clear the flight deck for continued operations
4. To isolate the crash in order to minimize danger of the fire spreading

4-36. Which of the following items of equipment will be immediately thrown over the side in the event that an aircraft crashes into the sea alongside the ship during foggy weather?
1. Dyemarkers
2. A two-man liferaft and liferings
3. Sealed electric float lights
4. All of the above

4-37. Which of the following problem areas may complicate jettisoning an aircraft?
1. The equipment on board to work with
2. The aircraft's location, attitude, and condition
3. The time available for the operation
4. Any of the above

4-38. From which point on a carrier is an aircraft usually jettisoned?
1. The aft end of the flight deck
2. The forward end of the flight deck
3. The side nearest the crash scene
4. The outboard side of the nearest deck edge elevator

4-39. The best way to jettison an aircraft is for the ship to execute a high-speed turn in the direction of the side of the ship on which the aircraft is located, and the list created by the turn will cause the aircraft to fall free.

4-40. Flash point is described as the point at which a liquid reaches a temperature sufficient to emit vapors capable of ignition.

Learning Objective: Recognize procedures, tools and equipments, and precautions applicable to crew entrapment and rescue.

4-41. Which of the following constitutes the greatest problem in aircraft fire fighting?
1. Hydraulic fluid
2. Gasoline and jet fuels
3. Anti-icing fluids
4. Grease and oil

4-42. The use of light water and P-K-P greatly reduces the possibility of a back flash.

4-43. Which of the following should a supervisor include in his training curriculum?
1. Aircraft description covering the location of fuels, oxygen, and pressure lines
2. Procedures for cockpit entry
3. Precautions to be followed in personnel rescue
4. All of the above

4-44. The fastest way for a rescueman to remove an unconscious pilot's safety belt and shoulder harness is to cut them with a rescue knife.

4-45. Although extreme caution should be exercised in removing aircrew members who appear to be injured, rescuemen should NOT hesitate to remove them from dangerous locations because of the ever present danger of flash fire.

4-46. Extreme caution must be observed when breaking canopies covering ejection seats because the
1. blows may actuate the seat ejection mechanism
2. pilot may have armed the seat
3. crash may have armed the seat
4. broken plexiglass may arm the seat

4-47. What tool, if available, should be used to forcibly enter a canopy which is primarily all metal?
1. A crowbar
2. A Halligan tool
3. A standard hatchet size fire axe
4. A portable, electrically powered metal cutting saw

4-48. Which vehicle is most ideally constructed as a rescue vehicle?
1. A TAU truck
2. A runway foamer nurse truck
3. An MB-1 firefighting and rescue truck
4. An MB-5 firefighting and rescue truck



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4-49. The TAU truck carries a generator which has four service outlets, two of which furnish 230-volt, 3-phase ac, and the other two furnish 110 volts ac. What do the 230-volt, 3-phase ac outlets supply power for?
1. The floodlights
2. The circular saws
3. The conventional electric tools
4. All of the above

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Learning Objective: Recognize the operating principles, nomenclature, capabilities and limitations; operating, troubleshooting, maintenance, and inspection procedures for the shore-based chain arresting gear (E-5 Mod 1/2/3).

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4-50. What two principles are involved in the energy absorption characteristics of the chain arresting gear?
1. Weight and aircraft engaging speed
2. Aircraft engaging speed and runway length
3. Unit mass and weight
4. Unit mass and runway length

4-51. What components connect the cross-deck pendants to the chain of the E-5 arresting gear?
1. Three-way coupling and "D" ring
2. Two-way coupling and tensioning pendant
3. Tensioning pendant and shear pin assembly
4. Three-way coupling and retensioning hook assembly

4-52. How far from the edge of the runway are the deadman anchors located for the E-5 arresting gear?
1. 5 ft
2. 10 ft
3. 12 ft
4. 15 ft

4-53. The E-5 Mod 1 emergency recovery equipment is similar to the E-5 arresting gear except for the
1. amount of chain for runout
2. size of the deck pendants
3. tensioning assembly used
4. length of the deck pendants

4-54. What is used to measure aircraft runout and the length of chain pullout for the E-5 arresting gear?
1. Painted marks on the runway
2. Painted marks on the chain
3. A syncro-repeater in the tower
4. A meter located on the panel at the edge of the runway

4-55. The E-5 Mod 2 field arresting gear is basically the E-5 gear with the chain arranged to allow the deck pendants to be rigged at either end of the chain.

4-56. What is the maximum recommended engaging speed for the E-5 or the E-5 Mod 2 chain gear?
1. 180 kt
2. 175 kt
3. 165 kt
4. 150 kt

4-57. What determines the maximum aircraft runout capacity for the chain arresting gear?
1. Aircraft speed and chain weight
2. The chain weight and length
3. The length of the available runway only
4. The type of aircraft to be landed and the length of the runway

4-58. When installed and prior to use, all arresting gear installations must be inspected and certified by the Naval Air Engineering Center.

4-59. How should you determine the correct length of the deck pendants to be used with the E-5/E-5-1 chain arresting gear?
1. Add 5 feet to the runway width
2. Add 10 feet to the runway width
3. Subtract 20 feet from the runway width
4. Add 20 feet to the runway width

4-60. What size deck pendant would be required for a runway with a width of 200 feet?
1. 195 ft
2. 200 ft
3. 210 ft
4. 220 ft

4-61. What are retention hooks used for on the E-5 Mod 1/3 chain gear?
1. To connect the tensioning pendant to the deadman anchor
2. To space the deck pendants
3. To tension the deck pendants
4. To connect the deck pendants to the chain

4-62. If the engaging speed is less than 100 knots and the aircraft runout distance is less than 500 feet, the deck pendant of the E-5 chain gear may be inspected in the installed position.

4-63. Regardless of its condition, how long may a deck pendant of the chain arresting gear remain in service?
1. 6 mo
2. 8 mo
3. 10 mo
4. 12 mo

4-64. What is the minimum number of wire supports per deck pendant on the chain arresting gear?
1. 14
2. 12
3. 10
4. 8

4-65. When positioning the wire supports on the deck pendants of the chain arresting gear, the supports are installed 15 feet on either side of the center line.

4-66. When checking the height of the bottom of the cable between supports on the chain arresting gear, what is the allowable height?
1. Maximum of 5 in.
2. Minimum of 5 in.
3. Maximum of 2 in.
4. Minimum of 2 in.

4-67. If, upon normal inspection, you find that the retention hooks on the chain arresting gear have rotated, what malfunction most probably occurred during an arrestment?
1. The deck pendant clevis pin did not clear
2. The tensioning pendant anchor pins released from their anchor foundations
3. The dowell pins failed
4. The three-way coupling broke

4-68. After how many arrestments on the chain arresting gear must the retention hooks be removed and inspected?
1. 15
2. 10
3. 3
4. 5

4-69. An indication of proper deck pendant tension on the chain arresting gear is indicated when the spring compression of the tensioning system is
1. 6 in.
2. 2 in.
3. 8 in.
4 4 in.

4-70. How many feet are there in a "shot" of chain?
1. 60 ft
2. 90 ft
3. 100 ft
4. 120 ft

4-71. Wrought iron chain is the most durable type of chain to be used for the E-5 Mod 1, 2 and 3 emergency arresting gear ashore.

4-72. When laying the chain for the E-5 arresting gear in a straight line and parallel to the edge of the runway, how far from the edge of the runway must it be laid?
1. One foot
2. Two feet
3. Three feet
4. Four feet

4-73. Aircraft runout distance is measured from the point at which the aircraft engages the deck pendant to where the aircraft's hook comes to rest.

4-74. What is the recommended runway length for an A-3 aircraft when the chain arresting gear is being used?
1. 1,500 ft
2. 1,800 ft
3. 2,000 ft
4. 2,300 ft

4-75. To determine the maximum chain length that may be used for a given available runout, you should determine the available runout length, subtract 1/2 the arresting cable length from it, and divide the remainder by two.



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# Assignment 5

E-27/E-15 and E-28 Arresting Gear

Text: Pages 106 - 139

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Learning Objective: Recognize the operating principles, nomenclature, limitations; operating, trouble-shooting, inspection, and maintenance procedures for the E-27/E-15 shore-based arresting gear.

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5-1. With respect to the E-27 pit installation, how many arresting engines direct the tape under the runway to connect to the other end of the deck pendant?
1. One, with double-tape reels
2. Two, with single-tape reel
3. Two, with double-tape reels
4. One, with single-tape reel

5-2. Which of the following installations consists of one deck pendant and one nylon purchase tape for each engine?
1. E-27 single-pit
2. E-15 above-deck
3. E-27 above-deck
4. E-27-1 double-pit

5-3. How many purchase tapes make up the E-15 above-deck split installation?
1. One
2. Two
3. Three
4. Four

5-4. On the E-27/E-15 arresting gear, what action must be taken prior to arrestment of an aircraft if the engines were just retracted to battery?
1. The rewind pin must be manually disengaged
2. The selector valve must be placed in the "Dump" position
3. The selector valve must be turned off to allow the hydraulic pressure to decrease to zero
4. The clutch locks must be released

5-5. The static brake pressure accumulator assembly at the E-27/E-15 arresting gear server a dual purpose. The upper half is a gravity fluid reservoir which stores hydraulic fluid, and the lower half is a nitrogen-charged accumulator which supplies static brake pressure.

5-6. On the E-27/E-15 arresting gear, in what position must the selector valve be to return hydraulic fluid from the brake accumulator back to the reservoir?
1. Charge
2. Brake
3. Arrestment
4. Clutch

5-7. When the static selector valve of the E-27/E-15 arresting gear is in the "Dump" position, the brake accumulator pressure is directed to the multiple disc brakes.

5-8. When is the overrun clutch assembly of the E-27/E-15 arresting gear disengaged, thus preventing hydraulic pump operations?
1. During arrestment
2. When the static selector valve is in the clutch position
3. During retraction
4. When the static selector valve is in the change position

5-9. A tell-tale gage is installed in the hydraulic system of the E-27/E-15 arresting gear to record the maximum hydraulic brake pressure reached during an arrestment.

5-10. What is the brake pressure charge in the brake accumulator of the E-27/E-15 arresting gear prior to arrestment?
1. 400 psi
2. 300 psi
3. 250 psi
4. 175 psi

5-11. What is the pre-charge pressure in the clutch accumulator on the E-27/E-15 arresting gear?
1. 300 - 400 psi
2. 400 - 450 psi
3. 500 - 600 psi
4. 600 - 700 psi

5-12. What is the maximum number of arrestments that can be made on a deck pendant of the E-27/E-15 arresting gear?
1. 5
2. 15
3. 25
4. 50

5-13. A deck pendant must be replaced on the E-27/E-15 arresting gear if the engaging speed of the aircraft was over 160 knots.

5-14. If a deck pendant of the E-27/E-15 arresting gear is installed for 90 days, it must be replaced with a new one regardless of its condition.

5-15. Purchase tapes that have the equivalent of 30 arrestments in accordance with criteria charts found in the Technical Manuals and bulletins must be replaced.

5-16. What are used to minimize tape wear in the sewn loop area during the retraction phase of operations of the E-27/E-15 arresting gear?
1. Rollers
2. Rubber bearing pads
3. Dollies
4. Canvas boots

5-17. How may a deck pendant on the E-27/E-15 arresting gear be centered during retraction if it is severely off-center?
1. By engaging the overrun clutch on one engine
2. By placing the static selector valve in the brake position to produce a drag on the tape
3. By hooking a tractor to the side of the tape that is the shortest and pulling it out until the pendant is centered
4. By holding the short side and retracting the long side

5-18. The E-27/E-15 arresting gear must have an inspection of the rewind, drive system, purchase tapes, and hydraulic system if there have been no arrestments for how long a period?
1. One week
2. One month
3. One quarter
4. Six months

5-19. What is the required tape stack height after a new tape has been replaced on the E-27 arresting gear?
1. 1 1/2 to 2 1/2 in.
2. 2 in.
3. 1/2 to 1 1/2 in.
4. 1/2 to 3/4 in.

5-20. All surfaces of exposed tapes on the E-27/E-15 arresting gear from the runway edge sheave assembly to the tape connector should be coated with what type of grease or preservative?
1. GP grease
2. GRG grease
3. Light oil (2190)
4. GACO

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Learning Objective: Recognize the operating principles, nomenclature, and limitations; operating, inspection, and maintenance procedures for the E-28 shore-based arresting gear.

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5-21. The E-28 arresting engines use what braking principle to dissipate the kinetic energy of the landing aircraft?
1. Rotary hydraulic
2. Rotary friction
3. Piston drag and fluid displacement
4. Air and fluid compression

5-22. What is the amount of tape tension that is required to release the cam release mechanism on the E-28 during an arrestment?
1. 1,000 lb
2. 2,000 lb
3. 3,500 lb
4. 5,000 lb

5-23. What provides the power source for the retrieving system of the E-28 arresting gear?
1. A 24-volt electric motor
2. A rotary vane hydraulic motor
3. A gear-driven hydraulic motor
4. A gasoline engine

5-24. All the controls for the retrieving system of the E-28 emergency arresting gear are located in the base operations tower.

5-25. What size and type of deck pendants are used on the E-28 arresting gear?
1. 1 3/8-inch lang lay
2. 1 3/16-inch regular lay
3. 1 1/4-inch nonrotating wire rope
4. 1 1/2-inch rotating wire rope

5-26. What is the minimum deck pendant height for the E-28 arresting gear?
1. 5 1/2 in.
2. 2 in.
3. 3 in.
4. 5 1/4 in.

5-27. A functional inspection of the E-28 arresting gear must be performed every 30 days.

5-28. Which of the following conditions would require the arrester tape of the E-28 arresting gear to be replaced?
1. The tape is worn more than 1/16 inch 20 feet from the pendant tape connector assembly
2. There are 105 arrestments on the purchase tape
3. The severed loop has 3 or more complete transverse rows of failed stitching
4. The tape width is less than 9 inches

5-29. Under normal conditions, how long may the E-28 arrester purchase tape remain in service?
1. 6 mo
2. 9 mo
3. 12 mo
4. 18 mo

5-30. Purchase tapes on the E-28 arresting gear that are worn and coated with GACO should NOT be reversed for 425-foot deck span installations.

5-31. Which of the following criteria would be reason to replace a donut wire support?
1. Supports have radial cracks of 1/2 inch or more
2. GACO has worn off
3. Minimum deck pendant height cannot be attained due to excessive wear
4. Radial cracks of 1/4 inch or more

5-32. A deck pendant is considered excessively worn when there are 30 or more flat spots 1/2 inch or more in length in one complete strand for one cable pitch length.

5-33. An engagement of an aircraft on the E-28 emergency arresting gear at a speed of 165 knots would be counted as how many arrestments toward the total number of allowable arrestments for a cross deck pendant?
1. 1
2. 1 1/2
3. 3 1/2
4. 4

5-34. What is the total number of aircraft engagements permissible on a deck pendant before it must be replaced?
1. 5
2. 10
3. 15
4. 25

5-35. If a deck pendant is uncrated for six (6) months, it must be discarded.

5-36. A good rule of thumb to be used when replenishing the hydraulic system of the E-28 arresting gear is to destroy the containers to ensure that contaminants do NOT get back into the system.

5-37. What is the prescribed mixture of hydraulic fluid and distilled water for the E-28 arresting gear?
1. One part hydraulic fluid, two parts distilled water
2. Two parts hydraulic fluid, one part distilled water
3. Three parts hydraulic fluid, one part distilled water
4. One part hydraulic fluid, one part distilled water

5-38. In order to obtain a correct reading on a torque wrench, you must jerk the wrench until the nut or bolt is at the desired torque.

5-39. A dynamometer is a device used for measuring force or energy. It is most commonly used to measure tension.

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Learning Objective: Identify causes, classifications, effects, and prevention of fires; determine material and methods of extinguishing fires; and uses of protective equipment.

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5-40. Unless fire is rapidly and effectively extinguished, it may cause more damage than the initial casualty.

5-41. When there is a rapid chemical reaction that results in the release of energy in the form of light and noticeable heat, what do you have?
1. Burning
2. Flash point
3. Auto-ignition
4. Flammable range

5-42. With certain types of material slow oxidation can turn into fast oxidation. What may result when fast oxidation occurs?
1. Auto-ignition
2. Fire
3. Spontaneous combustion
4. All of the above

5-43. The lowest temperature at which a flammable substance gives off vapors that will burn when a flame or spark is applied is called the
1. explosive range
2. flash point
3. oxidation point
4. auto-ignition point

5-44. The auto-ignition point is the temperature at which spontaneous combustion occurs.

5-45. Fires are classified according to the
1. manner in which they burn
2. nature of the combustibles involved
3. extinguishing agent used
4. magnitude of the fire

5-46. The method(s) of extinguishment will never depend on the circumstances surrounding the fire.

5-47. When a firefighter extinguishes a fire, he does so by removing one (or more) of the three sides of the fire triangle. Therefore, the "removal of fuel" is actually a misnomer since it is NOT usually possible to remove the fuel.

5-48. In heat transference, the most dangerous way for heat to move from one place to another is by
1. convection
2. conduction only
3. radiation only
4. both conduction and radiation

5-49. Water is the only extinguishing agent that is used to eliminate the heat from the fire triangle.

5-50. A fire will NOT exist if the oxygen content is between 21 to 25 percent.

5-51. Before entering a compartment where a fire exists, the firefighter should be in proper dress. Proper dress should include which of the following?
1. A head lamp
2. A helmet
3. An OBA
4. All of the above

5-52. When a fire occurs in a closed compartment or under other conditions where there is NOT enough oxygen for the complete combustion of all the carbon in the burning material, the fire will produce a gas known as carbon monoxide.

5-53. Carbon monoxide is very dangerous NOT only because it is deadly when a firefighter breathes it, but because of its very wide range of explosiveness.

5-54. A violent explosion can occur from rotting food. This is because the rotting food produces a combustible gas known as hydrogen sulfide.

5-55. When there is insufficient oxygen in the air, a person will become unconscious if the oxygen content falls to less than the minimum of
1. 17 percent
2. 15 percent
3. 9 percent
4. 7 percent

5-56. When fighting fires, water fog extinguishes fires by two methods. One is by the cooling capacity of the finely divided water particles, and the second is by displacing the oxygen.

5-57. How, if at all, should water be applied to an electrical fire?
1. By a solid stream of water
2. By a high/low velocity water fog
3. By directing a solid stream off the overhead and letting the water drip onto the fire
4. Never

5-58. How does water fog afford considerable protection to the firefighter?
1. By screening the intense heat
2. By diluting and absorbing various vapors
3. By washing fumes and smoke from the atmosphere
4. All of the above

5-59. When introducing water fog into a compartment through a door or other accesses, the firefighter need NOT worry about standing in openings since all of the hot gases will be neutralized by the fine spray of the water fog.

5-60. A foam blanket that had been applied to a fire was laid to a depth of 10 inches. How long will it take the foam blanket to dissipate to a depth of 5 inches?
1. 3 hr
2. 6 hr
3. 8 hr
4. 10 hr

5-61. Light water (AFFF) works on a fuel fire in the same manner as protein foam; that is, the bubbles float on the burning fuel and form a vapor seal.

5-62. Which of the following is compatible with light water?
1. Low-expansion foam
2. High-expansion foam
3. Non-protein foam
4. Purple-K-Powder

5-63. Purple-K-Powder will extinguish a fire by
1. interrupting the chemical reaction
2. smothering the fire
3. removing the heat from the fire triangle
4. dissipating the fuel from the fire triangle

5-64. When extinguishing electrical fires, personnel using $CO_2$ should wear rubber gloves because
1. the horn will conduct electricity
2. the horn and hand grip will often freeze
3. the $CO_2$ itself will conduct electricity
4. the frost that collects on the horn is a conductor of electricity

# Assignment 6

Shipboard Firefighting and Damage Control

Text: Pages 139 - 166

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Learning Objective: Use oxygen breathing apparatus correctly and safely.

6-1. What type of oxygen breathing apparatus is currently being used by the Navy today?
1. M-5
2. A-2
3. A-3
4. M-7

6-2. Which of the following statements is correct with respect to the OBA?
1. It is entirely independent of outside air
2. It is designed to be worn in harmful gases/vapors
3. It is designed to be worn in smoke/dust
4. All of the above

6-3. Prior to donning the OBA, and after you check all straps, the metal slides should be positioned approximately how far from the ends?
1. 5 in.
2. 2 in.
3. 3 in.
4. 4 in.

6-4. Which of the following statements is INCORRECT concerning the OBA?
1. When picking up the OBA, always use the main casting
2. The wearer should be able to wear the apparatus in such a way that the facepiece does not shift or catch on the main housing
3. The metal slides are used as a final adjustment to position the apparatus to the body of the wearer
4. The waist straps should be as tight as possible in case you have to be pulled out of a compartment via the life line

6-5. To place the OBA into standby service, the canister must be inserted all the way up until it locks into place by means of a canister stop.

6-6. If the burning chlorate candle produces too much smoke, and venting becomes necessary, what must you do?
1. Remove the canister completely
2. Deflate the breathing bags and start over
3. Depress the vent valve until breathing is comfortable
4. Drop the canister from the plunger casting

6-7. To ensure spring tension in the timer bell, the wearer should rotate the pointer clockwise to 60; then, counter-clockwise to 45.

6-8. Since the canister can be started manually, the oxygen producing candle should be saved for an emergency exit since the candle will produce oxygen from 1 to 4 minutes.

6-9. Personnel who are well rested are able to manually start the chemical evolution in the canister quicker than a man who was working prior to donning the OBA.

6-10. OBAs must be tested at regular intervals. When testing, how many times is the inhale/exhale process repeated?
1. 5
2. 10
3. 15
4. 20

6-11. Along with the OBA, the air-line mask can be used to fight fires.

6-12. Which of the following is INCORRECT concerning the air-line mask?
1. Like the OBA, it has two eye pieces
2. It is a demand flow respirator
3. It has a buddy fitting
4. It uses low-pressure air

6-13. Should it become necessary to effect a rescue of a man wearing an OBA, how should it be accomplished?
1. By hauling him out by the steel tending line
2. By one man wearing an air-line mask
3. By two men, preferably, wearing OBAs
4. By one man with an air-line mask and a second with an OBA

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In items 6-14 through 6-16, select from column B the meaning of the tending line signals listed in column A.

| | A. OBA Signals | B. Meaning of Signals |
|---|---|---|
| 6-14. | 1 pull | 1. ADVANCE |
| 6-15. | 2 pulls | 2. HELP |
| 6-16. | 3 pulls | 3. TAKE UP |
| | | 4. I AM OK |

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6-17. The wearer of the proximity firefighting suit should NOT walk through flames or burning liquid.

6-18. For fire prevention, a good rule to follow is to maintain all firefighting equipment in a maximum state of readiness.

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Learning Objective: Determine which firefighting equipment and tools to use in fighting fires and recognize and make flight deck repairs.

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6-19. Who would become responsible for the operations of the repair 1-H station in the absence of the V-3 division officer?
1. MMC
2. HTC
3. ICCS
4. Hangar deck chief

6-20. Repair 1-H is fully manned during flight quarters only on orders from the
1. air officer
2. flight deck officer
3. hangar deck officer
4. operations officer

6-21. During GQ operation of the hangar deck lighting is the responsibility of the
1. air officer
2. engineering officer
3. hangar deck officer
4. electrical officer

6-22. Because of the difficulty in reaching a fire on the hangar deck, most of the firefighting equipment at that location can be operated by remote control from the conflag stations.

6-23. In addition to being equipped with an open-close pushbutton to operate foam monitors, the conflag stations are also equipped with controls for operating what other units?
1. The fire doors
2. The hangar bay lights
3. The elevator doors
4. All of the above

6-24. Which of the following is used at a foam monitor station but is NOT an item with which the station is equipped?
1. A 2 1/2-inch firehose
2. A 2 1/2-inch fog-foam nozzle and stream shaper
3. A 3 1/2-inch swivel-type monitor
4. A 3 1/2-inch fog-foam nozzle and stream shaper

6-25. A stream shaper should be put on a monitor's fog-foam nozzle when the fire is
1. confined to the deck
2. confined to an aircraft
3. very close to the monitor
4. over 40 feet from the monitor

6-26. Due to the possibility of fire whenever fueled aircraft are spotted on the hangar deck, the foam monitor should be aimed athwartship at an angle of elevation or depression whereby the greatest area may be covered.

6-27. The first and immediate response to a hangar fire will be made by the use of a/an
1. SBTAU
2. P-K-P extinguisher
3. $CO_2$ extinguisher
4. high-capacity fog-foam handline

6-28. Hangar deck fires generally take place on what section of the deck?
1. Aft section
2. Forward section
3. Midship section
4. In the general areas where the foam monitors are located

6-29. When fighting a hangar deck fire, if possible, you should direct the fire parties to converge on the fire from fore and aft positions simultaneously.

6-30. Why should a sprinkling system NOT be operated while the foam system is in use?
1. The sprinkling system is used for cooling only
2. The ship's pumps cannot supply enough pressure to operate both systems simultaneously
3. The sprinkling system breaks the foam blanket thereby creating the possibility of a reflash fire
4. Both 2 and 3 above

6-31. If a fire occurs on the hangar deck, fire quarters are sounded and immediate action is taken to accomplish which of the following?
1. Close the hangar doors to form a fire boundary
2. Turn on the foam monitor nozzle covering the area involved
3. Place the water curtains in operation at both extremities of the area involved
4. All of the above

6-32. The use of stream shapers is dependent upon the extent of the heat wave created by the conflagration.

6-33. What firefighting agent is presently replacing all protein foam in foam generating systems?
1. High-expansion foam
2. Low-expansion foam
3. Aqueous film-forming foam
4. Perfluoro-carbon foam

6-34. What color is the present AFFF concentrate?
1. Light blue
2. Light amber
3. Dark brown
4. Dish-water gray

6-35. What instrument is used to analyze the AFFF/salt-water mixture?
1. Refractometer
2. Dynamometer
3. Hydrometer
4. Pyrometer

6-36. To minimize corrosive action, the tanks should be maintained with at least
1. 90% AFFF solution and 10% salt water
2. 75% AFFF solution and 25% salt water
3. 50% AFFF solution and 50% salt water
4. 100% AFFF solution only

6-37. When an aircraft is sent to the hangar deck via the deckedge elevator, and a tailpipe fire occurs, what action should be taken?
1. Send the aircraft back to the flight deck and introduce $CO_2$ into the tail pipe
2. Apply $CO_2$ into the tailpipe while the aircraft is at the hangar deck level
3. Dry run the engine while the aircraft is at the hangar deck level
4. Send the aircraft back to the flight deck level and introduce P-K-P into the tailpipe

6-38. If an aircraft crashes on the flight deck during flight quarters, who is charged with the responsibility for the general supervision of the flight deck in the vicinity of the crash?
1. The air officer
2. The flight deck officer
3. The damage control officer
4. The aircraft crash and salvage officer

6-39. On an aircraft carrier, the damage control organization is an integral part of which department?
1. Air
2. Operations
3. Engineering
4. Maintenance

6-40. The first and immediate response to a flight deck fire will be made by the use of a/an
1. MB-5 truck
2. SBTAU
3. $CO_2$ fire extinguisher
4. P-K-P fire extinguisher

6-41. Not only must the members of a crash salvage team be trained to handle all aircraft crash and fire situations on the flight deck, but they must also possess a thorough knowledge of and be trained in nuclear, biological, and chemical warfare.

6-42. The orders to activate a permanent water washdown system originate in and are passed down by engineering control.

6-43. If the permanent water washdown system is converted to provide for light water capability for fighting flight deck fires, the metallic piping in the flight deck must be replaced with plastic piping.

6-44. The permanent water washdown system for any zone on the flight deck can be operated as a washdown system or light water fire-fighting system by pushbutton controls in PriFly Control or in the ship's pilot house. These controls have indicator lights which show all but which of the following?
1. INJECTOR ON
2. INJECTION OFF
3. SALT WATER OFF
4. SALT WATER ON

6-45. The fantail sprinkling system can be controlled only from Damage Control Central (DCC).

6-46. The permanent flight deck washdown system is preferred over the interim system since the permanent system does NOT interfere with flight operations.



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6-47. How are the portable pipes of the interim flight deck washdown system secured to the flight deck?
1. They are all equipped with supports which are lashed to the aircraft tiedown fittings
2. They are secured to the flight deck with 40d nails which have been specially adapted for that purpose
3. They are lashed to the aircraft tiedown pad eyes
4. They are lashed to pad eyes which are welded to the flight deck for that purpose

6-48. In case of damage to the flight deck from a crashed aircraft, prefabricated patches must be stowed in a convenient location ready for immediate use.

6-49. In what section of the NAVSHIPS Technical Manual should you look to find detailed instructions for making temporary repairs as opposed to semipermanent repairs?
1. Section 7
2. Section 2
3. Section 3
4. Section 5

Learning Objective: Identify the objectives and responsibilities of shipboard damage control.

6-50. Which of the following statements are basic objectives of shipboard damage control?
1. Localize damage as it occurs
2. Care for injured personnel and restore equipment as quickly as possible
3. Take necessary measures to prevent damage
4. All of the above

6-51. Due to the problems encountered during a war, the damage control organization must have different objectives during war time.

6-52. Who has the responsibility for providing continual inspections in accordance with PMS on damage control equipment?
1. Commanding officer
2. Executive officer
3. Departmental officer
4. Command duty officer

6-53. Which of the following personnel are specifically responsible for the prevention and correction of damage?
1. Engineer officer
2. Damage control assistant
3. Department head
4. Departmental damage control petty officer

Learning Objective: Determine the organizational structure of damage control repair parties and teams.

6-54. Within the standard shipboard organization, there are actually two damage control organizations.

6-55. At which of the following locations would you find the charts and diagrams showing casualty data?
1. Damage control central
2. Bridge
3. Departmental office
4. Each repair locker

6-56. If it becomes necessary to divide a repair party, how should this subdivision be identified?
1. By the next higher numerical number
2. By the next lower numerical number
3. By the number of the parent party followed by a letter
4. By the number of the parent party followed by a letter and a number

In items 6-57 through 6-60, select from column B the repair party responsible for the areas listed in column A.

| | A. Areas | B. Repair party |
|---|---|---|
| 6-57. | Main deck | Repair 8 |
| 6-58. | Ordnance repair | Repair 7 |
| 6-59. | Island structure | Repair 6 |
| 6-60. | Electronics repair | Repair 1 |

6-61. Which of the following functions must each repair party be able to perform?
1. Detect, identify, and measure dose-rate intensity
2. Sample and identify biological or chemical agents
3. Control and extinguish all types of fires
4. All of the above

6-62. Which of the following is NOT a requirement for a battle dressing station?
1. Ensure adequate firefighting equipment is available
2. Be manned by personnel from the medical department
3. Be accessible to stretcher bearers
4. On ships equipped with more than one battle dressing station, they should be well separated

Learning Objective: Identify operational procedures of the damage control organization.

6-63. The term "material condition of readiness" refers to the condition of material on board ship needed to perform its mission.

6-64. Which of the following statements is/are correct concerning a compartment check-off list?
1. Duplicate lists must be posted at each access
2. Alterations must be made by the DCA
3. Each list must state who is responsible for the closure of each fitting used
4. Both 2 and 3 above

In items 6-65 through 6-68, select from column B the personnel responsible for satisfying each condition listed in column A.

| A. Conditions | B. Personnel |
|---|---|
| 6-65. Approves a request to modify the set condition | 1. Division officer |
| 6-66. Responsible for setting condition X-RAY | 2. Department head |
| 6-67. Responsible for setting condition YOKE | • 3. Repair party officer |
| 6-68. Responsible for setting condition ZEBRA | 4. OOD |

6-69. In reference to the material conditions, it is just as important to report the temporary closing of a fitting that should be open, as it is to report the opening of one that should be closed.

6-70. The rubber gaskets located around doors, hatches, and scuttles must be replaced if they have a permanent crease of how many thousandths of an inch?
1. 0.100 in.
2. 0.110 in.
3. 0.125 in.
4. 0.150 in.

6-71. What type of inspection is used for most compartments above the main deck to check for watertight integrity?
1. Visual
2. Air pressure
3. Water pressure
4. Steam pressure

# Assignment 7

**Administrative Procedures**

**Text:** Pages 167 - 180

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Learning Objective: Identify contents and uses of publications referred to when ordering materials, parts, and equipment through the supply system, and recognize advantages of the FOCSL.

7-1. In order to be an effective supervisor, what must be done by a senior petty officer?
1. Satisfy his superiors
2. Ensure his men are content in their work
3. Constantly analyze his abilities
4. All of the above

7-2. In order to be effective a training program must include methods of avoiding unnecessary expenses.

7-3. Which of the following statements is NOT recommended concerning the upkeep of a bulletin board?
1. The bulletin board should be located in a prominent location
2. Expired notices should be promptly removed
3. Information should be displayed in a standard manner
4. Safety posters should be changed frequently

7-4. In order to maintain safe working conditions, you must have a thorough indoctrination of new personnel and a continuing safety program.

7-5. In order for a maintenance crew to discover and eliminate unsafe work practices, the responsibility must be delegated to which of the following?
1. The leading chief
2. The leading petty officer
3. The work center supervisor
4. Each individual in the crew

7-6. In order for a safety program to be effective, it must include which of the following conditions?
1. Ensure safety precautions are easily complied with
2. Incorporate safety lessons in the formal training lessons
3. Explain each safety subject in detail
4. All of the above

7-7. You may obtain the manufacturer's part number of a part by referring to the manufacturer's parts list and catalog or to the nameplate on the part.

7-8. Significant among the advantages of the Fleet Oriented Consolidated Stock List (FOCSL) is the fact that less man-hours need to be expended for catalog maintenance.

7-9. What publication, published in four parts, contains information pertinent only to aeronautical material?
1. Federal Supply Catalog
2. Navy Stock List of ASO
3. Master Cross-Reference List
4. Fleet Oriented Consolidated Stock List

In item 7-10, refer to the following sections of the Navy Stock List of the Aviation Supply Office (ASO):
- A. Cross-Reference Section C0009
- B. Price and Management Data Section
- C. Descriptive Sections
- D. Parts List Sections

7-10. If the National stock number of a part is known, which of these sections will be used to find an equivalent part?
1. A and C
2. A and D
3. C only
4. D only

Learning Objective: Indicate proper procedures for processing requisitions for different types of material, including information to be contained thereon.

7-11. To expedite identification and issue of requisitioned material, it is important that the requisition form include which of the following?
1. The stock number
2. The nomenclature
3. The manufacturer's part number
4. All of the above

7-12. The form used for requisitioning technical material to be issued to the V-1 division is first submitted to the
1. supply office
2. aviation stores division
3. storeroom in which the material is stowed
4. air officer or his authorized representative

7-13. If you submit a request for an item of in-excess material, you must justify in writing why the item is needed and why the authorized material will NOT suffice.

7-14. The single-line item requisition, DD Form 1348, is the request document for the procurement of in-excess material and nonstandard material as well as for standard material.

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Learning Objective: Recognize responsibilities and procedures associated with surveying and inventorying equipment/material.

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7-15. Formal surveys are conducted by personnel appointed by the
1. cognizant office or bureau
2. commanding officer of the surveying activity
3. supply officer of the surveying activity
4. head of the department having custody of the material to be surveyed

7-16. Who is the survey officer if the material is being disposed of by an informal survey?
1. The supply officer of the surveying activity
2. The commanding officer of the surveying activity
3. The head of the department having custody of the material
4. The head of a department other than the one having custody of the material

7-17. In which order do the following steps occur in completing a formal survey?
A. The cognizant department head submits a rough NAVSUP Form 154 requesting survey of material
B. The NAVSUP Form 154 is forwarded to the designated survey officer
C. Smooth copies of the survey form are prepared in accordance with local instructions and are forwarded to the commanding officer
D. The commanding officer reviews the survey recommendations and, if he approves, forwards a copy to the fleet command
E. The item is expended in accordance with the survey recommendations after the commanding officer approves
F. The commanding officer designates the survey officer
G. Diciplinary action is taken if culpability is established
1. A, B, C, D, E, F, G
2. A, B, C, D, G, E, F
3. A, C, F, B, D, E, G
4. A, C, G, F, D, E, B

7-18. At which of the levels given below do the basic recommendations pertaining to the need for survey, expenditure, disposition, or requisition of equipage originate?
1. Fleet command
2. Supply department
3. Systems command
4. Division

7-19. For what purposes(s) are custody cards maintained on specific equipage?
1. As a means of designating custodial responsibility for the equipage
2. As a means of identifying the items which should be in custody during inventory
3. As a means of indicating the exchange of D, E, R, and L coded items when applicable
4. All of the above

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Learning Objective: Relative to technical publications, recognize contents, purposes, forms of changes, and applicable procurement and maintenance procedures.

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7-20. Technical manuals serve as a reference for which of the following?
1. Operating pertinent equipment
2. Maintaining pertinent equipment
3. Correcting malfunctions of pertinent equipment
4. All of the above

7-21. New and recently revised technical manuals contain information relative to all but which of the following?
1. Operating theory
2. Troubleshooting techniques
3. Corrective maintenance
4. Preventive maintenance

7-22. Manual-type publications are ordered direct from NATSF, Philadelphia, Pa. on DD Form 1149, and letter-type publications are obtained from the nearest supply point by using DD Form 1348.

7-23. Changes to technical publications can be issued in all but which of the following forms?
1. Looseleaf pages
2. Complete revisions
3. Pen-and-ink changes
4. Supplements

7-24. An obsolete page removed from a publication must be destroyed immediately to prevent it from becoming inadvertently reinserted in the publication.

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Learning Objective: Recognize types of records, reports, and schedules used by the ABH, their uses, and applicable completion and disposition procedures.

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7-25. The Unsatisfactory Material/Condition Report (UR), OPNAV 4790/47, is a mandatory report used to collect, compile, and analyze all reports of failures, deficiencies, or malfunctions for what purpose(s)?
1. To correct material deficiencies
2. To determine the areas of immediate failure and trends toward impending failure
3. To improve flight safety, operational utility, and logistic support for operating aircraft
4. All of the above

7-26. In what catagory should you place the reporting of a deficient material condition which, if NOT corrected, could cause extensive damage or destruction to equipment?
1. Routine
2. Safety
3. Special
4. Urgent

7-27. Where will you find instructions for preparing a UR on an item of firefighting gear?
1. On the first page of the UR
2. In the pertinent Maintenance Instructions Manual
3. On the back of the last page of the UR
4. On the first page of the gear's maintenance log

7-28. When a UR is prepared, what disposition is made of the filled-in pages?
1. Original - originating activity; file - attached to the material; tag-NATSF (MR)
2. Original - attached to the material; file-NATSF (MR); tag-originating activity
3. Original - NATSF (MR); file - originating activity; tag - attached to the material
4. Original - NATSF (MR); file - attached to the material; tag-originating activity

7-29. What document is used for preparing a preliminary rough draft of a UR for internal application only?
1. OPNAV 43-P2
2. OPNAV 4790/2K
3. OPNAV 4790/47A
4. OPNAV 4970

7-30. Detailed instructions for filling out URs can be found in
1. OPNAV 43-P2
2. OPNAV 4790-2K
3. OPNAV 4790-2L
4. OPNAV 4790.2A

7-31. To which of the following manuals should you refer to find the latest changes to the 3-M system?
1. OPNAV 43P2
2. OPNAVINST 4790.2A
3. OPNAVINST 4790.4
4. NAVAIR 5100 series

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